City of San Marcos
Water Master Plan Update
August 2020

PLUMMER

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1 Executive Summary

The City of San Marcos (City) completed a Master Plan for its water distribution system in 2016 to guide the growth and development of the distribution system. Since that time the system has seen significant changes and is anticipated to experience rapid growth in the foreseeable future with the development of several new major residential neighborhoods and two new potable water sources. For these reasons, the City retained Plummer Associates, Inc. (Plummer) to complete an update to the Water Master Plan (WMP).

In the 2016 Water Master Plan Update, the hydraulic model software was upgraded from Bentley WaterCAD to Innovyze InfoWater which functions directly within a geographic information systems (GIS) environment. The City's hydraulic model was updated and recalibrated to existing conditions. Field data collected in April 2014 were used to perform the updated model calibration. Calibration of the computer model was aided by the abundant data available from the City's Advanced Metering Infrastructure (AMI) system. Having actual hourly consumption data for every meter in the system facilitated the distribution of demands and allowed for the development of precise diurnal curves. As a result, strong calibration was achieved.

Significant changes in the City's distribution system have occurred that warrant an update to the WMP. Over the past three years, the City's participation in the Alliance Regional Water Authority resulted in the first phase of the project moving forward, which will deliver 5,379 ac-ft/yr of treated water supply. In addition, according to development plans, the City is expected to add almost 60,000 people to the water service area in the next fifteen years. Finally, the City's water service area has changed from the previous WMP. Notable changes include acquisition of the Crystal Clear Water Supply Corporation (Crystal Clear) service area along McCarty Lane and transfer of the service area south of Old Bastrop and east of Centerpoint to Crystal Clear. This Water Master Plan update provides a plan for the construction of capital improvements that allow the distribution system to effectively serve all developed areas within the City's Certificate of Convenience and Necessity (CCN) boundary and to ensure the efficient use of the new ARWA water supply.

Up-to-date spatial data for meter locations, current pipe network, and pressure plane boundaries were received from the City and incorporated into the existing model. From the infrastructure information received, the plans for new developments, and the projected water use (gallons per capita per day, or gpcd) goals, a future system model was developed for each of the following years: 2025, 2030, and 2035.

The modeled future demand and future infrastructure were evaluated for regulatory compliance and operational efficiency. Using the criteria described in the master plan, a list of projects for the City's Capital Improvements Program (CIP) was developed to meet state regulations and the City's operational requirements.

The 2020 Water Master Plan Update provides a revised capital infrastructure plan through 2035 as well as an updated hydraulic model of the potable water distribution system that incorporates new planned developments and water supplies. This report presents a summary of the modeling effort and a revised capital improvements project list (CIP List) as of March 2020.

Table ES.1: CIP Cost Opinions

Infrastructure Type	2025	2030	2035
Pumps / Wells	$ 7,200,000	$ -	$ 1,234,000
Pipes	$ 14,609,000	$ 12,112,000	$ 5,318,000
Tanks	$ 7,326,000	$ 4,493,000	$ -
Total	**$ 29,135,000**	**$ 16,605,000**	**$ 6,552,000**

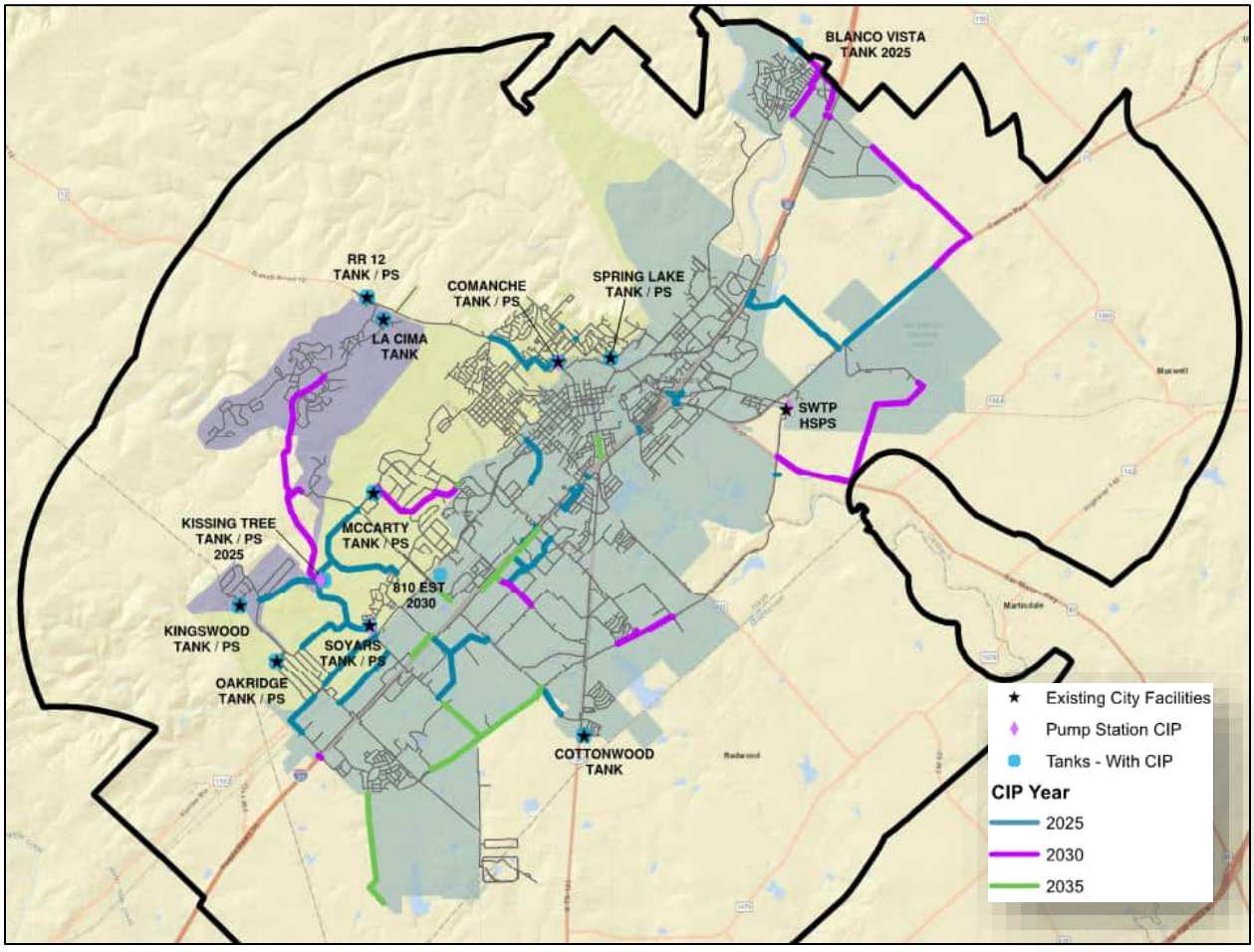


Figure ES.1: Water Distribution System with CIP

2 Introduction

The City of San Marcos provides water service to residents and businesses located within its CCN. The City is located in Hays County in Central Texas. The City completed a Master Plan for its water distribution system in 2016 to guide the growth and development of the distribution system. Since that time the system has seen significant changes and is anticipated to experience rapid growth in the foreseeable future with the development of several new major residential neighborhoods and two new potable water sources. For these reasons, the City retained Plummer Associates, Inc. (Plummer) to complete an update to the Water Master Plan (WMP).

The purpose of this evaluation is to provide the City with an updated water system model and to develop recommendations for system improvements through 2035 based on growth projections and new water supply contracts.

The following activities were defined in the project scope and were completed by Plummer for the development of the WMP update.

1. Perform data collection and system asset inventory.
2. Analyze existing data.
3. Develop preliminary existing system model.
4. Perform an evaluation for the regulatory compliance of the existing system.
5. Develop the future year demand distribution.
6. Coordinate with Alliance Regional Water Authority (ARWA) and Guadalupe Blanco River Authority (GBRA) concerning the new water source.
7. Develop and execute future year model scenarios.
8. Develop a Capital Improvements Projects (CIP) list.
9. Evaluate and recommend a City supply plan.

The efforts completed in the 2016 Master Plan included calibration of the model infrastructure, determination of friction factors for different pipe materials, development of diurnal curves for demand nodes, and maximum day / peak hour multipliers. Overall, the calibration of the 2016 hydraulic model was very successful which can be attributed to the availability of advanced metering infrastructure (AMI) data. Additionally, Hazen Williams C-factors from the old 2007 model were imported to the new 2016 InfoWater model where possible. New pipes added since 2007 were assigned an initial C-factor based on pipe material (ductile iron = 130, PVC = 150). These C-factors were attributed to new pipes in the 2020 model, as well. The availability of AMI data led to the development of new, more precise diurnal curves and refined maximum day and peak hour demand multipliers. Details about the methods of determination of these factors can be found in the 2016 Water Master Plan.

3 Existing System Overview

The City of San Marcos owns and operates a potable water distribution system to provide service to customers within its service area. The system is comprised of the following components:

- 9 MGD capacity from the regional Surface Water Treatment Plant (SWTP)
- Six active wells and well pumps at five separate sites
- Nine storage tanks (five of which serve as elevated storage to at least one pressure plane) and two clearwells at the SWTP
- Seven pump stations
- Six pressure reducing valves (PRVs)
- Over 1.3 million linear feet of pipe, mostly comprised of ductile iron or polyvinyl chloride (PVC)

3.1 Existing System Model

The demands and demand distribution for the year 2020 were previously developed in the 2016 Water Master Plan. The 2016 model was used to create a model of the City's current potable water system as of May 2019. The operation of the pumping stations and wells remained the same and the water demand for each modeled node was checked against the recent meter data received from the City.

Several CIP projects from the 2016 WMP have been implemented since its completion, including the following:

- CIP 2: New 0.5 million gallon (MG) Elevated Storage Tank (EST) for 1063 pressure plane (La Cima EST) and new pumps at the Ranch Road (RR) 12 storage tank to fill the La Cima Tank.
- CIP 4: Connect Soyars Tank to 936 pressure plane.
- CIP 5: Close gap between existing 16 inch (in.) in Hunter Rd. southwest of McCarty Ln and Soyars tank
- CIP 7: Complete 24 in. main by joining end of line at McCarty Rd. to IH-35 just north of the Premium Outlets.
- CIP: 9 Upsize existing 12 in. main to 16 in. main along E. McCarty Ln. just north of Old Bastrop Hwy.
- CIP 11: Initial portion of Kissing Tree Loop to Phase I of Development
- CIP 41.I: Upsize lines to 8 in. PVC in Fairlawn neighborhood along Crepe Myrtle Dr. and IH-35 frontage road.
- Other Project: Install new 14 in. pipeline crossing the San Marcos River at Cheatham St.

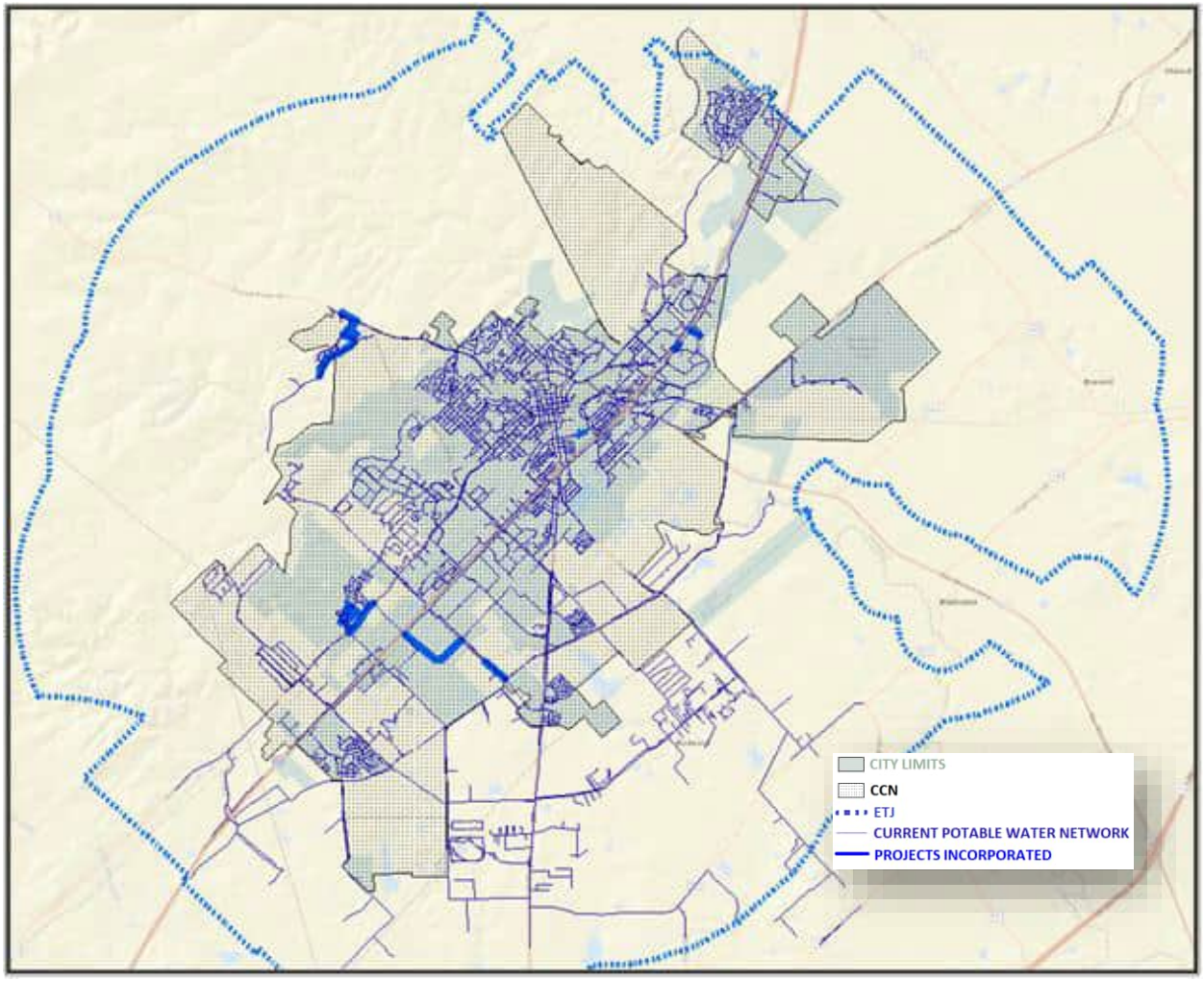


Figure 1: CIP Projects Incorporated Since 2016

These seven projects were incorporated into the 2019 model. In addition, development growth in the Kissing Tree, Blanco Vista, and La Cima neighborhoods was also included in the model.

3.2 Acquisition of Crystal Clear Service Area

The neighborhood along McCarty Ln., previously operated by Crystal Clear, will soon be served by the City's water system. At present, the City is operating the neighborhood using the inherited infrastructure for Crystal Clear. This includes the existing pipe network, two groundwater wells (390 gpm and 400 gpm), a ground storage tank with pumping station, and an elevated storage tank. It is anticipated the City will connect this neighborhood to its distribution system sometime in late 2020. The geospatial data from the City shows a potential interconnect between the Crystal Clear system and the City's system along Stagecoach Trail and another interconnect along McCarty Ln. as seen in Figure 2. It is not anticipated that the connection effort with need to be associated with a CIP project, rather, the connection can be achieved through the manipulation of valves along Stagecoach Trail and McCarty Ln.

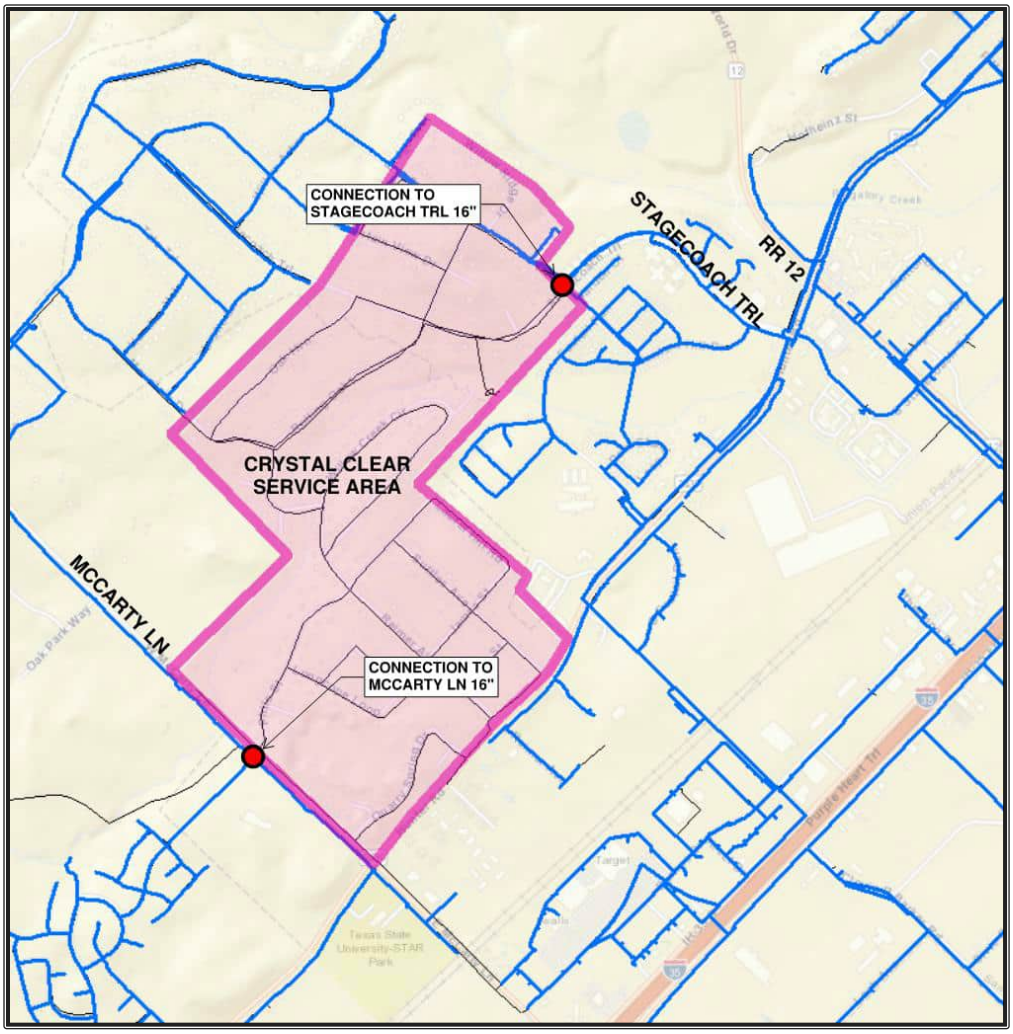


Figure 2: Area Previously Serviced by Crystal Clear

The elevation range of the meters in the Crystal Clear area is 670-ft to 730-ft. Given this elevation information, the area will be incorporated into the 936 pressure plane.

Following integration into the City's system in late 2020, the pumps at the ground storage tank are no longer needed to serve this area or any other area of the City's network. Since they are not necessary, the ground storage tank and pumps were not included in the modeled scenarios but should be maintained by the City as an emergency backup water supply. The overflow elevation of the existing Crystal Clear elevated storage tank along McCarty Ln. is 842-ft and the bottom of bowl elevation is 812-ft. At these elevations, the elevated storage tank is not able to serve as elevated storage with the City's previously defined pressure planes and is not needed to satisfy regulatory requirements. Therefore, this elevated storage tank is proposed to be demolished as CIP # xx.

The historical meter data which was received from Crystal Clear indicated that the entire area had an average annual water use of 8.8 million gallons (MG) or 17 gpm (gallons per minute). The total demand was distributed equally over the modeled nodes to simulate the neighborhood's demand distribution.

3.3 Existing System Regulatory Evaluation

The rules and regulations for public water systems are established by the Texas Commission on Environmental Quality (TCEQ) in Title 30 of the Texas Administrative Code, Chapter 290, Subchapter D (30 TAC § 290). This section discusses the regulatory requirements applicable to the City's public water system with respect to water supply, storage, and pumping capacity.

Water Supply

The regulations found in 30 TAC § 290.45(b)(2)(B) require that all surface water supplies meet a treatment plant capacity of 0.6 gpm per connection. The City applied for and received (June 11, 2015) a variance allowing an alternative capacity requirement (ACR) for its water supply requirements. The variance allowed a reduced total capacity for production. The City was granted a minimum ACR as follows:

Total Production (Groundwater + Surface Water) ≥ 0.32 gpm/connection

Based on the existing potable water demand, the number of customer connections to the City's system, and the City's existing infrastructure, the City is in full compliance with the approved ACR (Table 1).

Table 1: Existing Water Supply

Water Supply	Total Production (gpm)
Treated Surface Water	6,250
Ground Water Pumps	
Spring Lake Well	6,360
Comanche Well	2,700
Soyars Well	400
McCarty Well	400
Oakridge Well	-
Kingswood Well	200
Crystal Clear Well	390
Total	16,700
Estimated Number of Connections (2019)	31,486
gpm / connection	**0.53**
Meets ACR (0.32 gpm / conn)	Yes

The number of connections were determined in the 2016 WMP by counting connections and calculating a system wide demand per connection of 0.21 gpm / connection. Since we have current data on water usage, connections were determined by dividing average day demand by the average demand per connection.

Water Storage

Existing storage and storage requirements are summarized in Table 2. As indicated, the existing system meets 30 TAC § 290 requirements for total storage and elevated storage.

Pumping Capacity

TCEQ requirements for pumping are dependent upon available elevated storage. The required pumping capacity is the lesser of 2.0 gallons per minute (gpm) per connection or the ability to meet peak hour demands with firm pumping capacity and a total capacity of at least 1,000 gpm. The calculated demand based on 2.0 gpm per connection would require a pumping capacity significantly greater than the current or future planned facilities for the City. Therefore, the ability to meet peak hour demands with firm pumping capacity is evaluated for current conditions.

Table 3 summarizes the current pumping capacity information compared to the peak hour demands for each pressure plane. TCEQ requirements are satisfied in all cases.

Table 2: Existing Water Storage

Storage Facilities by Pressure Plane	Active Head Range	Tank Style	2019				
			Number of Connections	Required Total Storage[1] (MG)	Active Total Storage (MG)	Required Elevated Storage[2] (MG)	Active Elevated Storage (MG)
1063-FT			**578**	**0.1**	**1.5**	**0.1**	**0.5**
Ranch Road 12	905 - 936	Ground			1.0		
Kingswood GST	884 - 900	Ground			0.04		
La Cima	1025 - 1063	Elevated			0.5		0.5
936-FT			**9,689**	**1.9**	**2.4**	**1.0**	**1.0**
Ranch Road 12	905 - 936	Elevated			1.0		1.0
Comanche Standpipe	762 - 810	Ground			0.7		
Soyars Standpipe	742 - 805	Ground			0.3		
Oakridge GSTs (x2)	738.5 - 760	Ground			0.08		
McCarty Standpipe	758 - 810	Ground			0.3		
810-FT			**21,219**	**4.2**	**7.0**	**2.1**	**2.5**
Excess 936-FT Storage	N/A	Elevated			0.0		0.0
SWTP Clearwells (x2)		Ground			3.0		
Spring Lake GST	610 - 636	Ground			1.5		
Comanche Standpipe	762 - 810	Elevated			0.7		0.7
Cottonwood Elevated Tank	771 - 810	Elevated			1.1		1.1
McCarty Standpipe	758 - 810	Elevated			0.3		0.3
Soyars Standpipe	742 - 805	Elevated			0.3		0.3
System Total [3]			**31,486**	**6.3**	**8.6**	**3.1**	**3.9**

[1] Required Total Storage in Plane is 200 gallons per connection. (30TAC§290.45)

[2] Required Elevated Storage in Plane is 100 gallons per connection when connections exceed 2,500. (30TAC§290.45)

[3] Total system storage only accounts for each tank once, although in a few cases a tank may serve two pressure planes at once.

Table 3: Existing Water Pumping

Pressure Plane	Pump Station	2019					
		Number of Connections	2019 Average Annual Demand (gpm)	2019 Maximum Day Demand (gpm)	TCEQ Required Firm Capacity[1] (gpm)	Total PS Capacity (gpm)	Firm PS Capacity (gpm)
810-FT	SWTP HSPS	21,219	3,914	6,427	8,595	11,582	7,416
	Spring Lake					8,610	6,360
	Total per Plane					**20,192**	**13,776**
936-FT	Comanche	9,689	1,787	2,935	3,925	3,000	1,800
	Soyars					1,200	600
	McCarty					600	400
	Oakridge - Not Active					0	0
	Total per Plane					**4,800**	**2,800**
Kingswood Plane	Kingswood	578	107	175	234	400	200
	Total per Plane					**400**	**200**
La Cima Plane	Ranch Road 12					3,600	2,400
	Total per Plane					**3,600**	**2,400**
Total		**31,486**	**5,808**	**9,537**	**12,754**	-	-

4 Population and Water Demand Projections

Water service area population and water demand projections were based on the projections for future developments performed for the 2016 WMP. Adjustments were made to account for the differences between projections based solely on population and the residential development predicted by the detailed development plans. The following sections describe the methodology used to estimate water demand projections used in the hydraulic model. This chapter also presents the discussion for determining maximum day demands, peak hour demands, and diurnal variations. Table 4 and Figure 3 demonstrate the projected growth in the City's service area. The city limits, extra jurisdictional territory, and certificate of convenience and necessity (CCN) area are shown in Figure 4.

Table 4: Projected Service Area Population

	Region L Projections (Within City Limits)	Development-Based Projections	Difference (ETJ Population and Additional Growth)
2019	N/A	65,234	-
2020	71,135	N/A	-
2025	77,998	89,372	11,374
2030	84,861	102,695	17,834
2035	93,048	133,701	40,653

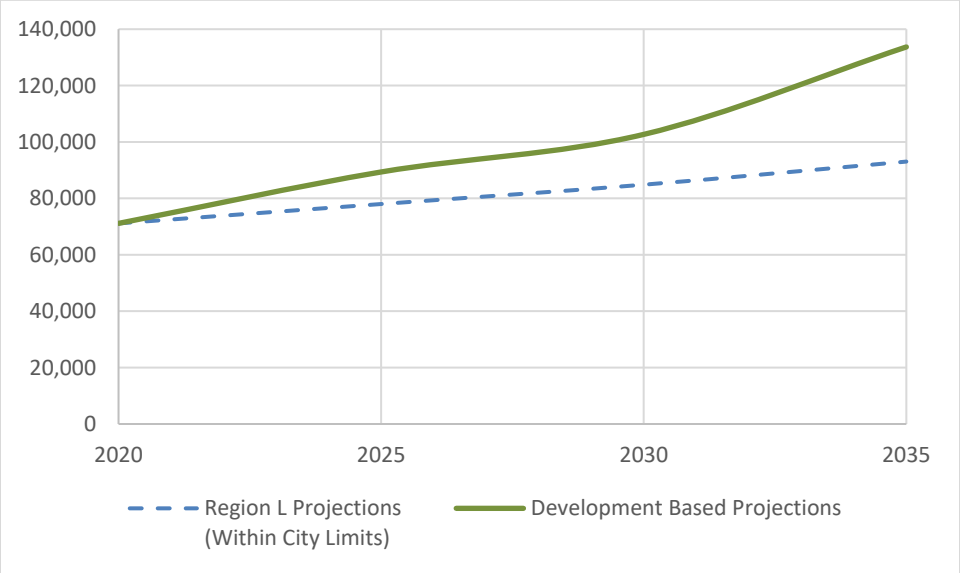


Figure 3: Service Area Population Projections

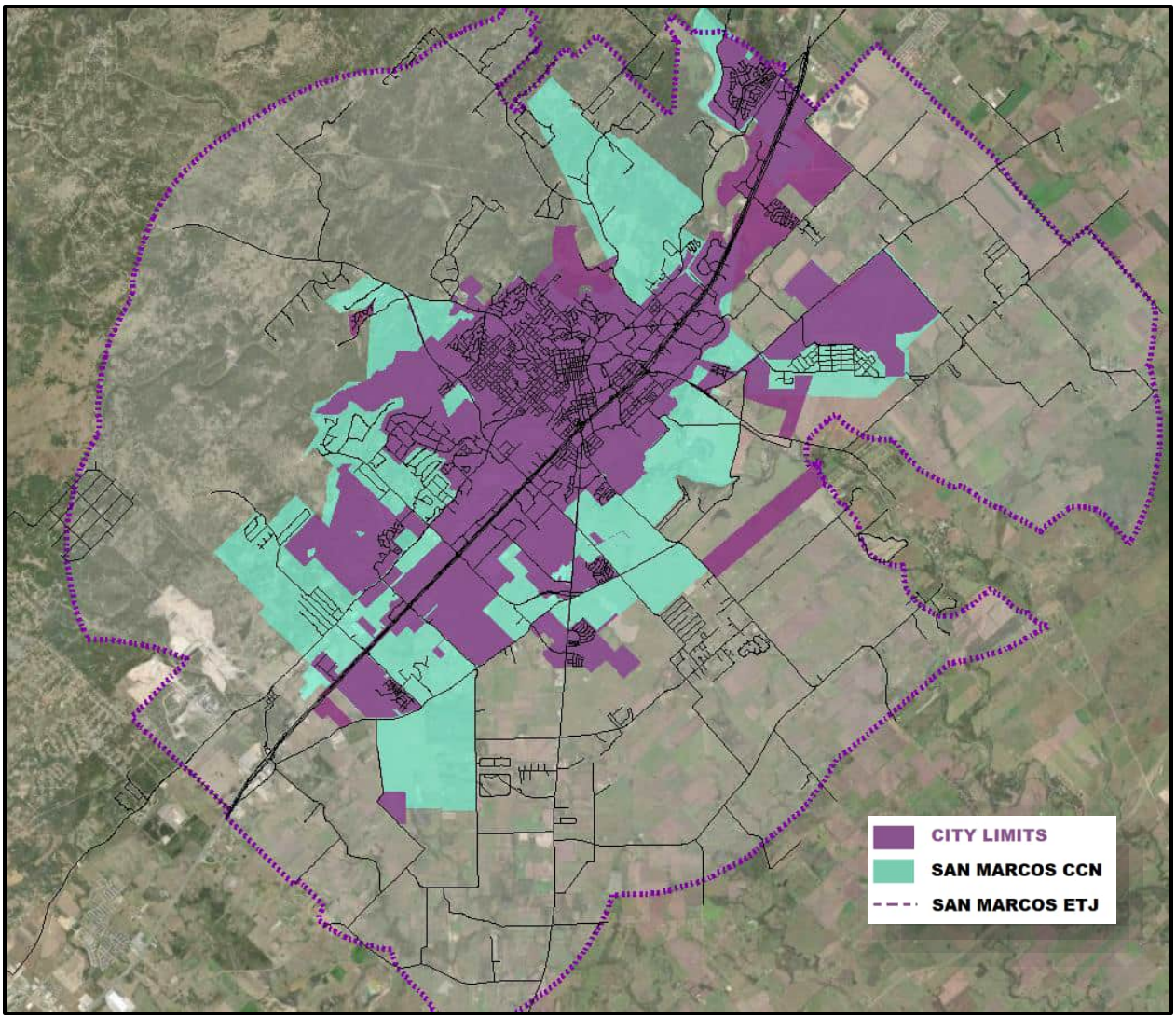


Figure 4: Water Service Area Map

4.1 Future Demand Projections

As populations increase, the demand for potable water will increase in the City's service area. According to the City's Comprehensive Plan (2013), with local conservation efforts, it is projected that the per capita demand will drop from 122 gpcd in 2019 to 112 gpcd in 2035. Although the population projections presented in the Region L Water Plan (Table 4) show less growth than the table below, the development and demand projections received from the City dictated the growth projections. After consulting with City staff, Plummer utilized the higher population projections which were back calculated from known water demand projections.

Table ***5*** and Figure 5 show the population and demand projections for each of the future modeling scenarios. Figure 6 shows how the total demand depends on the demand of the developers.

The value of 0.21 gpm / connection determined in the 2016 WMP was used to project the number of connections in the future service area. This is consistent with the projected per capita demand for the City.

Table 5: Total Projected Demands

	Service Area Population Estimate	Projected GPCD[1]	Average Day Demand Estimate (gpm / MGD)
2019	65,234	128	5,808 / 8.4
2025	89,372	116	7,199 / 10.4
2030	102,695	114	8,130 / 11.7
2035	133,701	112	10,399 / 15.0

[1] GPCD projections have been recently been updated by the City's Water Conservation and Drought Response Plan (April 2019). The projections presented in the plan predict a demand of 112 gpcd in 2025, 110 gpcd in 2030, and 109 gpcd in 2035. For th purposes for the planning document, the higher demands shown in the table were used when predicting future water supply and infrastructure needs.

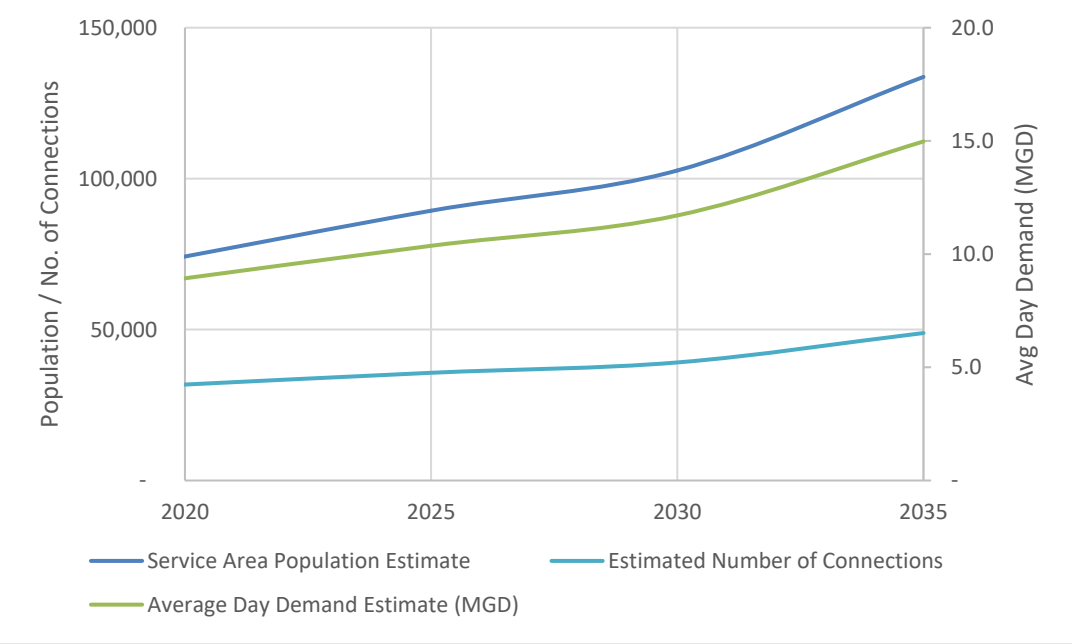


Figure 5: Population and Demand Growth

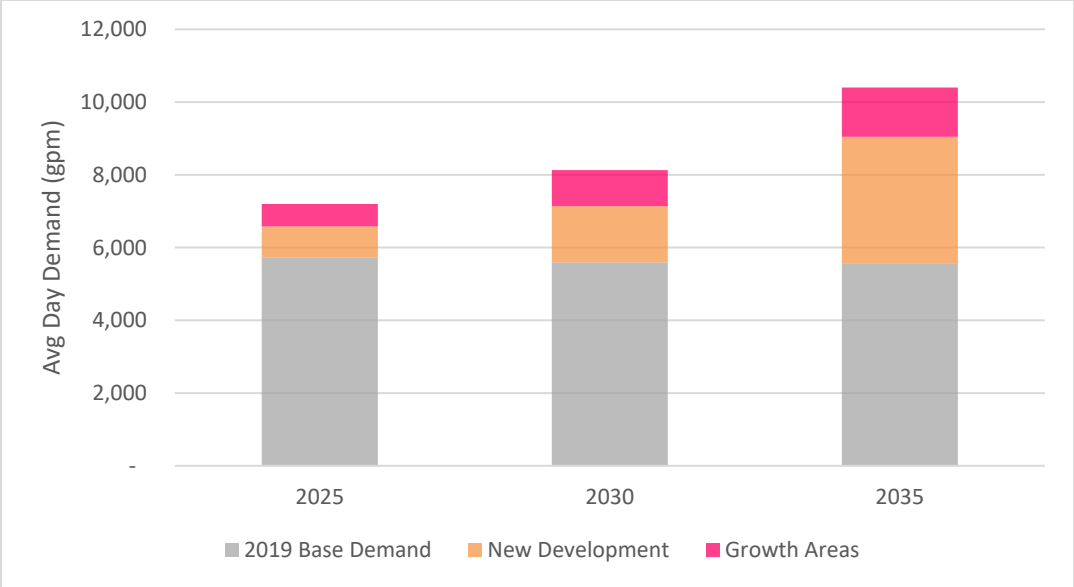


Figure 6: Growing Demand from Developments

Figure 7 shows the areas of the City's service area which are starting to develop or are growing in their demand in the next 10 years.

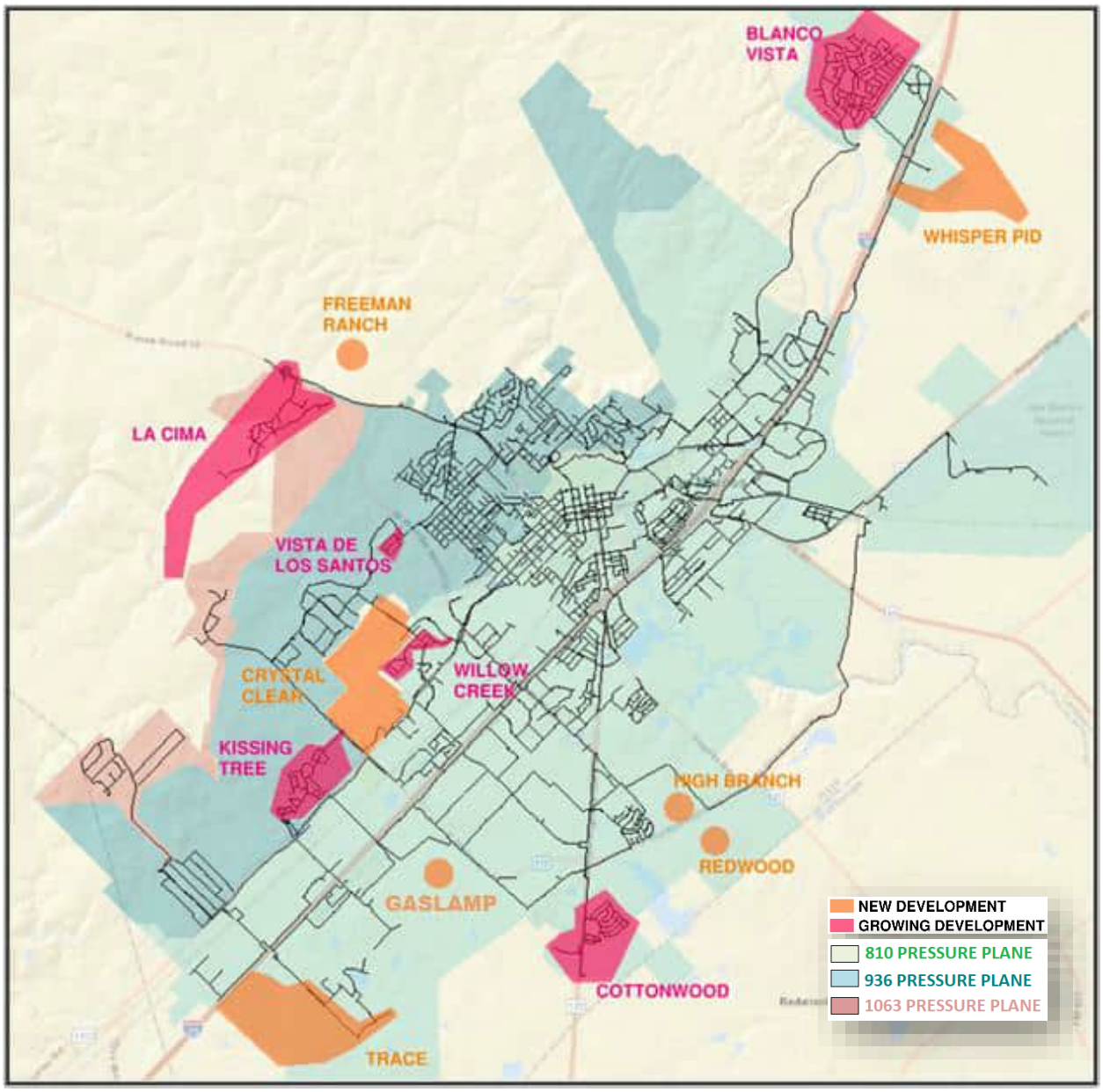


Figure 7: Growth and Development Areas

4.2 Growing Developments

Several developments which were included in the 2016 WMP have grown faster than previously assumed and thus the potable water demand has also increased as compared to initial estimates. In addition, greater growth has been projected based on availability of more detailed development plans. These developments are summarized in Table 6.

Table 6: Growing Development Areas

Development Name	Area Description	Pressure Plane
Blanco Vista	Mostly residential area on far north end of service area.	810
Cottonwood	Mostly residential area on far south end of service area.	810
Willow Creek	Smaller neighborhood of single-family homes, centrally located.	936
Vista de los Santos	Smaller neighborhood of single-family homes, centrally located.	936
Kissing Tree	Large new development just north of the Soyars pump station.	936
La Cima	Large new development on the north west end of the service area.	1063

Development projections were used to estimate the growth in demand over the next 15 years and modeled for each future year scenario.

Table 7: Annual Average Demand Projections – Growing Developments

Year	Blanco Vista	Cottonwood	Willow Creek	Vista de los Santos	Kissing Tree	La Cima	TOTAL Growth
Plane	810		936			1063	-
2025	182 gpm	70 gpm	24 gpm	8 gpm	89 gpm	245 gpm	618 gpm
2030	227 gpm	91 gpm	22 gpm	14 gpm	244 gpm	396 gpm	994 gpm
2035	304 gpm	125 gpm	22 gpm	14 gpm	343 gpm	547 gpm	1,355 gpm

4.3 New Developments

In additional to the growth areas described above, several new developments have been planned since completion of the 2016 WMP. These developments were added to the model for the future year scenarios and are summarized in Table 8.

Table 8: New Development Areas

Development Name	Area Description	Pressure Plane
Trace	A mix of residential and commercial development on the furthest southern end of the IH-35 corridor.	810
Whisper PID	A mix of residential and commercial development on the north east end of the service area.	810
High Branch	Smaller neighborhood of single-family homes, along HWY 123 in the eastern end of the service area.	810
Redwood	Smaller neighborhood of single-family homes, along HWY 123 in the eastern end of the service area.	810
Gaslamp	Large commercial / industrial development to the east of the Outlet Mall.	810
Willow Creek (Crystal Clear)	A centrally located neighborhood of older single-family homes recently adopted into the City's service area.	936
Freeman	A development on the Freeman Ranch located north west along RR 12.	1063

A discussion between Plummer and the City was held in mid-October in which the City indicated that a large new industrial development (Gaslamp) may become a major water user in the coming years. With direction from the City, it was assumed that in 2025 and 2030 the average day demand for the Gaslamp development would be 1 MGD of potable water. The Gaslamp average day demands would increase to 3.5 MGD in 2035 and could potentially be met with both potable water and non-potable water.

Development projections for other areas were used to estimate the growth in demand over the next 15 years and modeled for each future year scenario. If number of homes or apartments was known for the new development, demand per connection was used to estimate average water use. In some cases, only acres of land were estimated for different uses in the proposed development (single-family, multi-family, commercial, parkland, etc). For these developments, a standard number of units per acre was used to calculate the estimated number of service units per category. The number of units was then multiplied by the appropriate gpm per service unit equivalent (SUE) value from the City's Impact Fee Ordinance. The resulting demands are presented in Table 9.

Table 9: Annual Average Demand Projections – New Developments

Year	Trace	Whisper PID	High Branch	Redwood	Gaslamp	Willow Creek (Crystal Clear)*	Freeman	TOTAL Growth
Plane	810					936	1063	-
2025	25 gpm	88 gpm	53 gpm	117 gpm	694 gpm	13 gpm	-	992 gpm
2030	114 gpm	403 gpm	97 gpm	214 gpm	694 gpm	12 gpm	201 gpm	1,736 gpm
2035	241 gpm	851 gpm	97 gpm	214 gpm	2,450 gpm	12 gpm	201 gpm	4,078 gpm

**Demand for the Crystal Clear Area seems low for the number of homes which are being served. The demand presented in this table is based on data received from Crystal Clear which indicated an annual consumption of 8.8 MG.*

5 New Water Supplies

The majority of the City's water supply originates from surface water and is treated at the SWTP which is operated by GBRA. The surface water is delivered from the Guadalupe River via a raw water pipeline from an intake on a canal extending from Lake Dunlap. Groundwater extracted at each of the five well sites provides additional supply as needed. In 2019, groundwater made up 21 percent of the total water production with the other 79 percent coming from the SWTP.

The City operates and maintains six wells as follows:

1. Two wells at the Spring Lake Pump Station
2. One well each at the following facilities:
    - Comanche
    - McCarty
    - Soyars
    - Kingswood

It should be noted that since completion of the 2016 WMP, the two wells at the Oakridge Pump Station have been decommissioned due to influences of surface water and lack of available treatment.

Texas State University and Canyon Regional Water Authority Water Delivery

The City has obtained a lease for potable water rights from Texas State University's Canyon Regional Water Authority (CRWA). In May of 2019, a study was conducted to begin conceptual planning and analyses to define opportunities for CRWA and the City to utilize the nearby Hays Caldwell WTP (HCWTP or Maxwell Plant) and associated water distribution system to treat and deliver additional water that could be shared with CRWA members and the City.

The details of the proposed agreement and required WTP improvements are presented in Appendix G. In summary, the City would buy in to the improvements needed at the HCWTP and receive 1,314 ac-ft/year (1.2 MGD) of treated water from the HCWTP to be delivered directly to the City's distribution system. The water would be delivered to the City's system with a new high service pump station (HSPS) at the HCWTP and a 12 in. delivery pipeline installed along the north side of TX 80. The new 12 in. pipeline would connect into the existing 30 in. pipeline along Old Bastrop Hwy. near the intersection with TX 80 (see Figure 8).

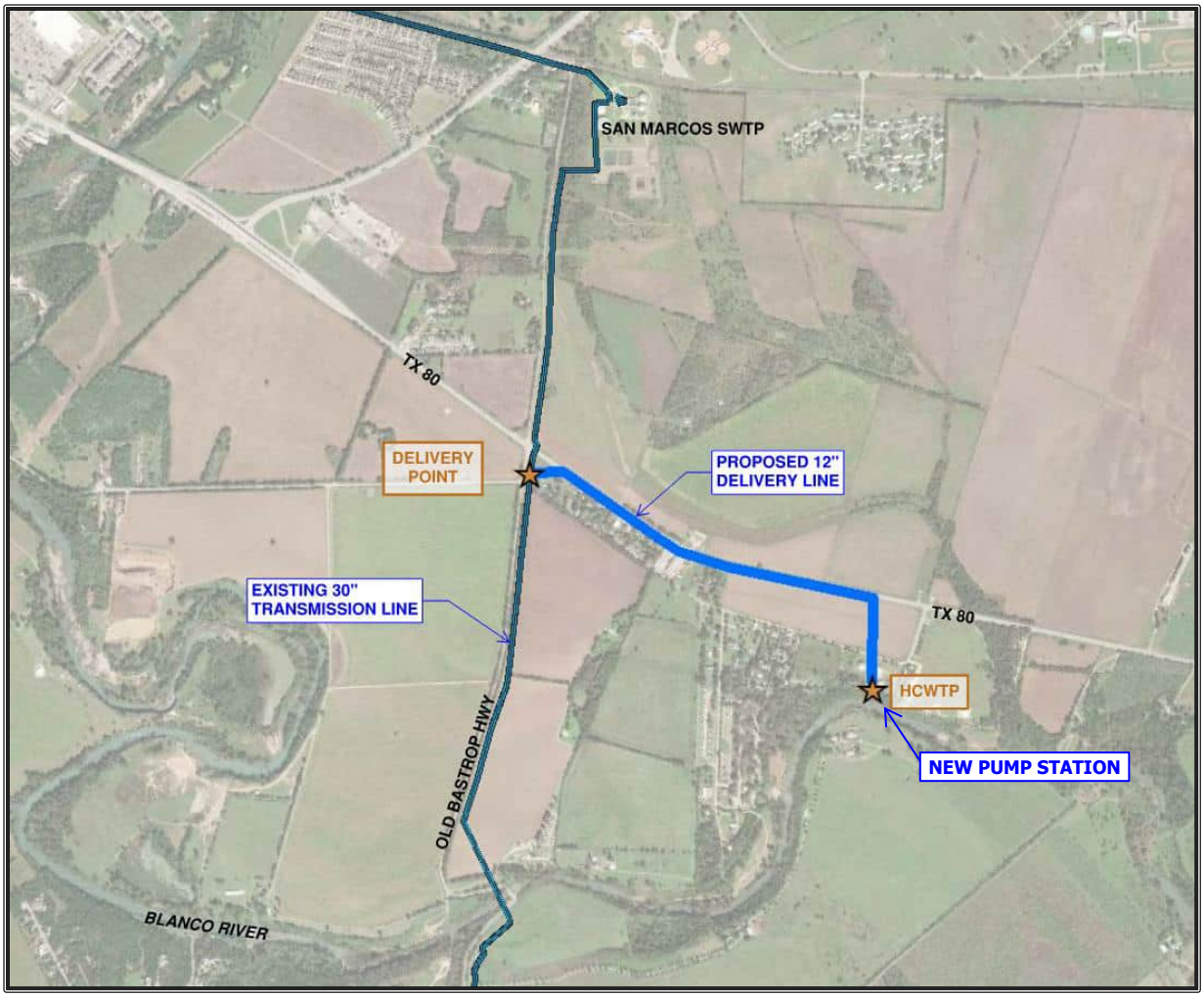


Figure 8: CRWA Delivery Location

Alliance Regional Water Authority Water Delivery

ARWA has leased groundwater rights in eastern Caldwell County and will deliver treated Carrizo Aquifer groundwater to various project sponsors, including the City, beginning in 2023 (Phase I). The City will maintain two delivery points for the new ARWA water supply – San Marcos 1, a ground storage tank at the City's SWTP, associated with the 30 in. ARWA Segment B pipeline and San Marcos 2, a new elevated storage tank in the Blanco Vista subdivision, related to the 30 in. ARWA Segment C pipeline (Figure 9).

The timing of the implementation of the Phase II infrastructure is difficult to predict since unknown factors for each project sponsor are still undetermined, such as their individual development rates and growth in population. Phase II construction will consist of a groundwater WTP expansion, pump station expansions, and paralleled transmission mains. For the Water Master Plan Update, an implementation date of 2035 is assumed for the Phase II delivery rates from ARWA. Table 10 shows the contracted delivery rates.

Table 10: Contracted Alliance Water

ARWA Phase	Contract Amount (ac-ft/yr)	Average Delivery Rate (gpm)	Peaking Factor	Peak Delivery Rate (gpm)
Phase I (2025)*	**5,379**	**3,335**	**-**	**5,003**
San Marcos 1 – SWTP	2,518	1,561	1.5	2,342
San Marcos 2 – BV EST	2,861	1,774	1.5	2,661
Phase II (2035)*	**12,798**	**7,935[1]**	**-**	**11,903**
San Marcos 1 – SWTP	5,991	3,715	1.5	5,573[1]
San Marcos 2 – BV EST	6,807	4,220	1.5	6,330[1]

** The City is allowed to accept the total amount of ARWA flow at either of their delivery points. For example, 5,003 gpm may be accepted by either delivery point 1 or delivery point 2 during Phase I. For Phase II, (Superscript 1) a maximum flow rate of 7,935 gpm may be accepted by either delivery point 1 or delivery point 2 and the total flow to the two delivery points cannot exceed 11,903 gpm (17.1 MGD).*

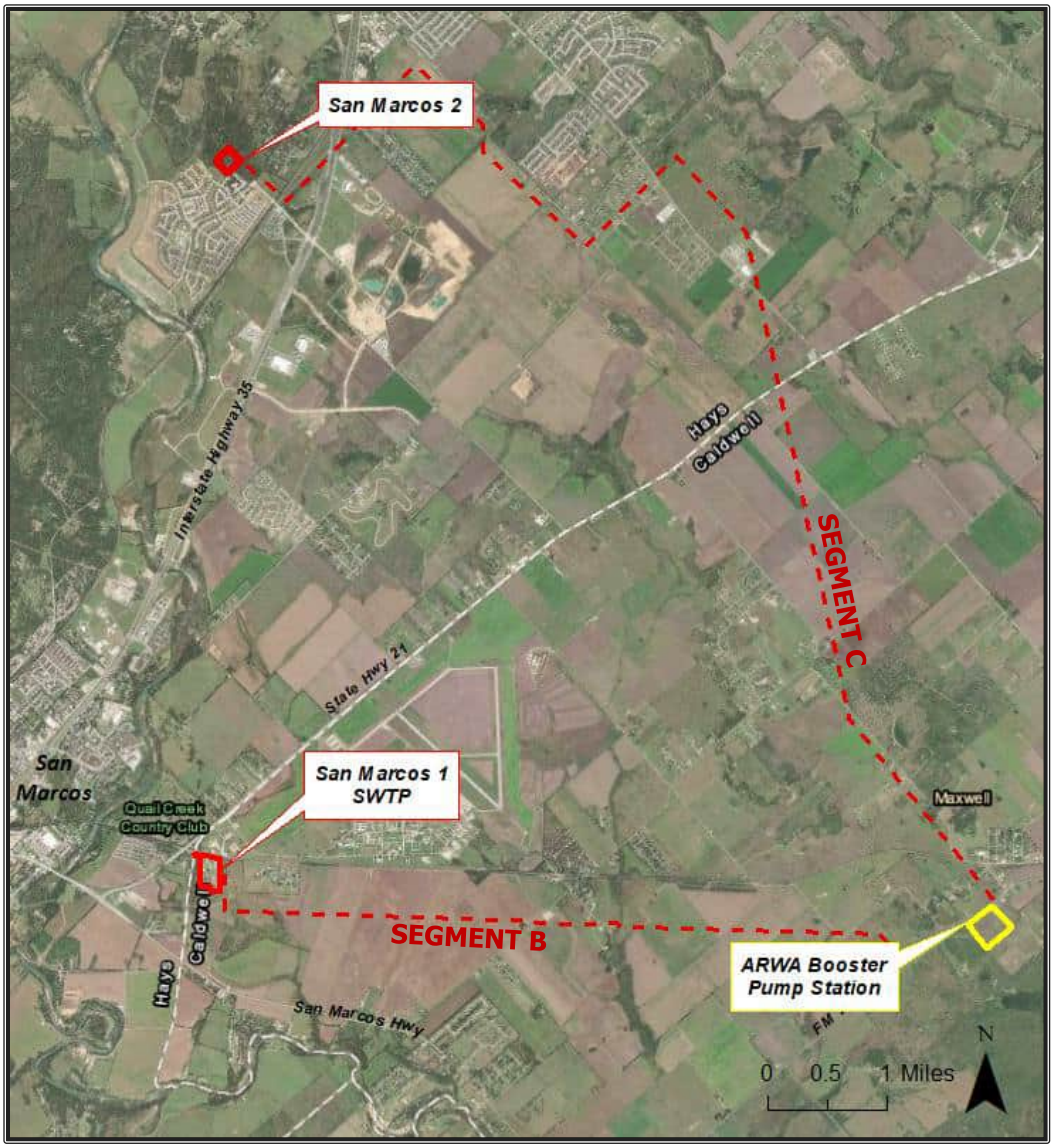


Figure 9: Alliance Regional Water Authority Delivery to the City of San Marcos

Table 11 summarizes the existing and future potable water supplies for the City's system.

Table 11: 2035 Available Water Supply

Source	Annual Average Supply
Surface Water	
San Marcos SWTP	10,088 ac-ft / year
Hays-Caldwell WTP	1,345 ac-ft / year
Groundwater	
San Marcos Wells – Edwards Aquifer (Firm)	19,010 ac-ft / year
ARWA Wells – Carrizo Wilcox Aquifer (Phase I & II)	12,778 ac-ft / year
Total Available	**43,221 ac-ft / year**

Finding new sources of water is critical to guaranteeing water reliability for the City's current and future customers. The City has a diverse water supply portfolio which helps meet future increases in water supply demand. The diversity of the City's water supply also ensures a reliable and consistent water service for its customers.

6 Future Year System Evaluation

Hydraulic modeling scenarios were developed for the average day and maximum day demand cases in each targeted future year. In general, the criteria used to identify the capital improvements needed to serve the projected demand in each target year were as follows:

- State regulatory criteria met for storage and pumping capacity;
- Meeting a target pressure of 35 psi during maximum day demand conditions at all service connections in the distribution system;
- Minimum allowable pressure of 20 psi under fire flow conditions;
- Headloss of less than 7 ft per 1,000 ft. in all pipes;
- Pipe velocities below 7 ft/s during maximum day demand conditions;
- Adequate fire flow availability (including 1,000 gpm for new connections, 500 gpm for existing connections) under maximum day demand conditions; and
- Reducing water age where feasible through looped connections to improve water quality and provide redundant water delivery pathways.

For new average day demands within future year simulations, the previously defined diurnal curves were assigned based on the pressure plane location and use. Additionally, the maximum day and peak hour multipliers were used from the 2016 WMP (Table 12).

Table 12: Maximum Day and Peak Hour Multipliers

MD:AD Multiplier (system wide average)	1.64
PH:MD Multiplier (system wide average)	1.34

Several model changes have been made since 2016 and are discussed below.

- Seven new developments have submitted plans to the City to request water service between 2020 and 2030 (see discussion of projected demands from these developments in Section 4.3). These developments were not yet proposed in 2015 and were not a part of the previous WMP. These include Trace, Whisper, High Branch, Redwood, and Freeman Ranch. In addition, the City has been in contact with a major industrial developer which will be built east of the outlet malls and referred to as the Gaslamp District. A previous iteration of the Gaslamp District development was modeled in the previous WMP as a mixed use development with an average demand of 26 gpm, just 4% of the demand of the new industrial user. In addition to the brand new development, the new acquisition of the Crystal Clear / Willow Creek service area has recently been confirmed.

- The 12 in. pipeline in Hunter Rd. has been modified to be operated permanently on the 936 plane due to low pressures at the fire station and veterinary clinic on Hunter Rd.
- Since the membrane treatment facility is no longer operational, the new model has retired the Oakridge Groundwater Facility. The Oakridge ground storage tank (GST) and pump station still serve the Deerwood neighborhood and 936 plane in the future scenarios.
- It is recommended that the SWTP pumps operate off of Comanche Standpipe levels as the Ranch Road 12 Tank is filled by the Comanche pumps. The model has been updated to control the SWTP pump with the water level in the Comanche Standpipe instead of the Cottonwood EST

Model results for the future year scenarios are provided in Appendix B, C, and D and include the following scenarios:

- 2025 – Steady State – Maximum Day Fireflow Availability
- 2025 – Extended Period Simulation – Maximum Day Minimum Pressures
- 2025 – Extended Period Simulation – Water Age
- 2030 – Steady State – Maximum Day Fireflow Availability
- 2030 – Extended Period Simulation – Maximum Day Minimum Pressures
- 2030 – Extended Period Simulation – Water Age
- 2035 – Steady State – Maximum Day Fireflow Availability
- 2035 – Extended Period Simulation – Maximum Day Minimum Pressures
- 2035 – Extended Period Simulation – Water Age

6.1 2025 System Updates

If the rapid growth projected over the next five years is realized, there will be significant capital improvements necessary to meet all water service criteria. The 936 pressure plane will be configured to include the newly acquired Crystal Clear service area along McCarty Ln. with a connection to the neighborhood through the 16 in. line along Stagecoach Trail and another 16 in. line along McCarty Ln.

The 936 pressure plane will be extended to the south and east to include any future developments on the south side of Hunter Rd.

To serve the continued growth of the Kissing Tree development, the Soyars Pump Station will be upgraded. The following major projects are also proposed to be incorporated into the system by 2025:

- Construct a new 1.0 MG EST to serve Kissing Tree and the 936 pressure plane and a new pumping station at the tank to boost water into the Kingswood pressure plane.
- Upgrade the existing 600 gpm pumps at the Comanche pump station to 1,250 gpm each bringing the total pumping capacity to 4,950 gpm with a firm capacity of 3,700 gpm.

- Improvements related to the new ARWA water source include a new 1.0 MG EST in the Blanco Vista neighborhood, a new 2.0 MG GST at the SWTP, and one new high service pump at the SWTP.

A number of water line projects will be needed to serve the new developments proposed for 2025 including La Cima, Kissing Tree, and Trace. Figure 10 depicts the proposed 2025 system, with all pressure planes identified. Appendix B contains additional figures showing minimum pressure nodes and fire flow availability results for the 2025 system.

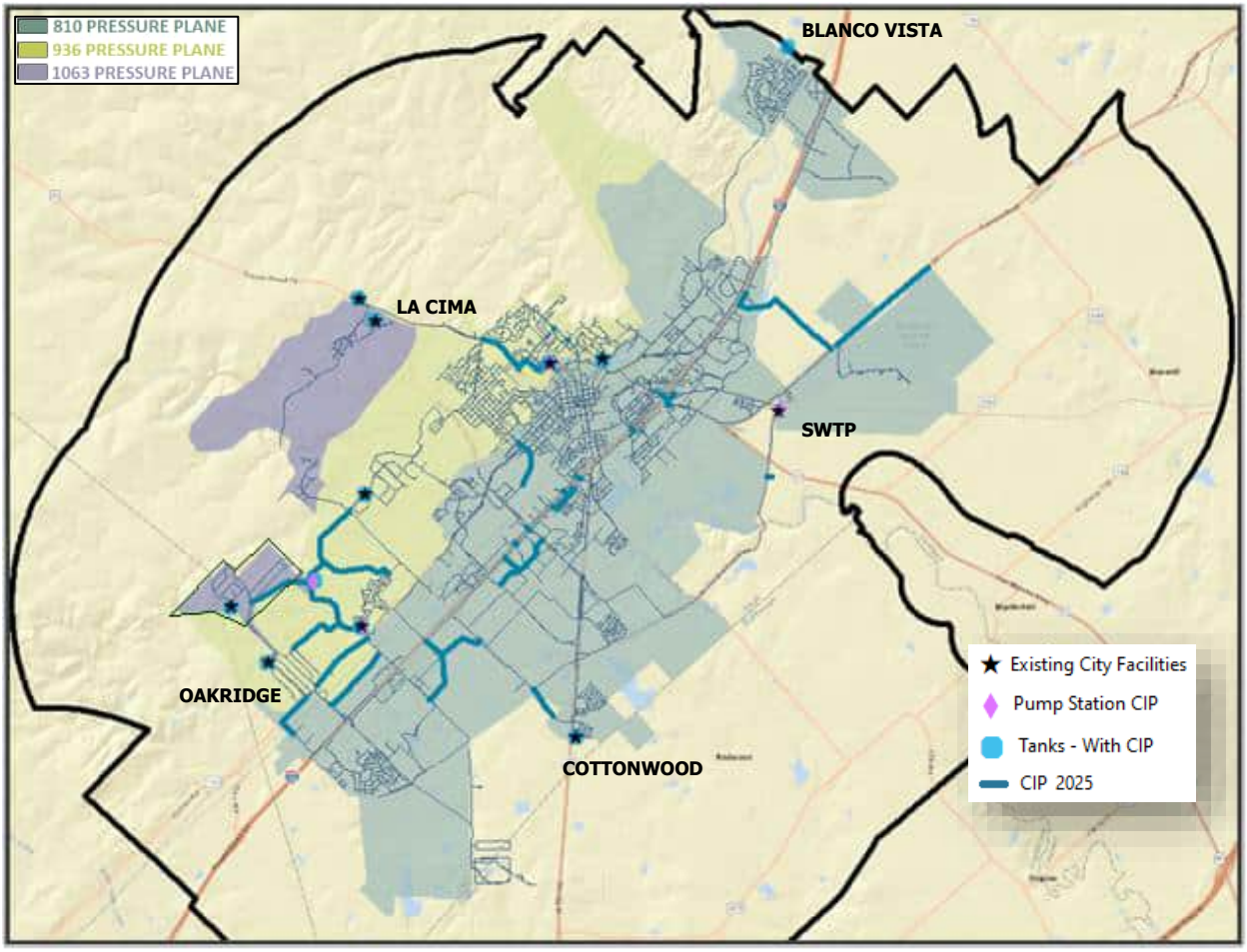


Figure 10: 2025 System Figure

6.2 2030 System Updates

The major projects that should be implemented by 2030 include the following:

- The McCarty Tank will be connected to the 810 pressure plane, providing additional elevated supply for this main zone. It should be noted that this tank will be operated at less than full as its overflow is currently 857-ft.
- Connect the new Kissing Tree PS to La Cima with a 16 in. water main. This project also includes an 8 in. line off the main to serve the Estates at San Marcos (PRV at 95 psi included). The La Cima development and Kingswood neighborhood will be joined into a single 1063 pressure plane with a 12 in. line.
- Installation of a new 1.0 MG EST along McCarty Ln. north of Hunter Rd. (actual location not yet determined). This tank will provide additional elevated storage for the 810 pressure plane, bringing the number of elevated gallons per connection within the acceptable range as set by the TCEQ (100 gal / connection). This tank will only be required if the population projections made by this report are fully realized. If the growth predicted for the year 2030 is slower than anticipated, this project can be pushed out into the future.
- Construct an outlet line from the Blanco Vista EST to Whisper PID on the east side of IH-35 and continue towards the new 12 in. on HWY 21 just north of the airport.

In 2030, the 1063 pressure plane will be fully connected through the RR 12 pump station, La Cima, and Kingswood. Figure 11 depicts the proposed 2030 system, with all pressure planes identified. Appendix C contains additional figures showing minimum pressure nodes and fire flow availability results for the 2030 system.

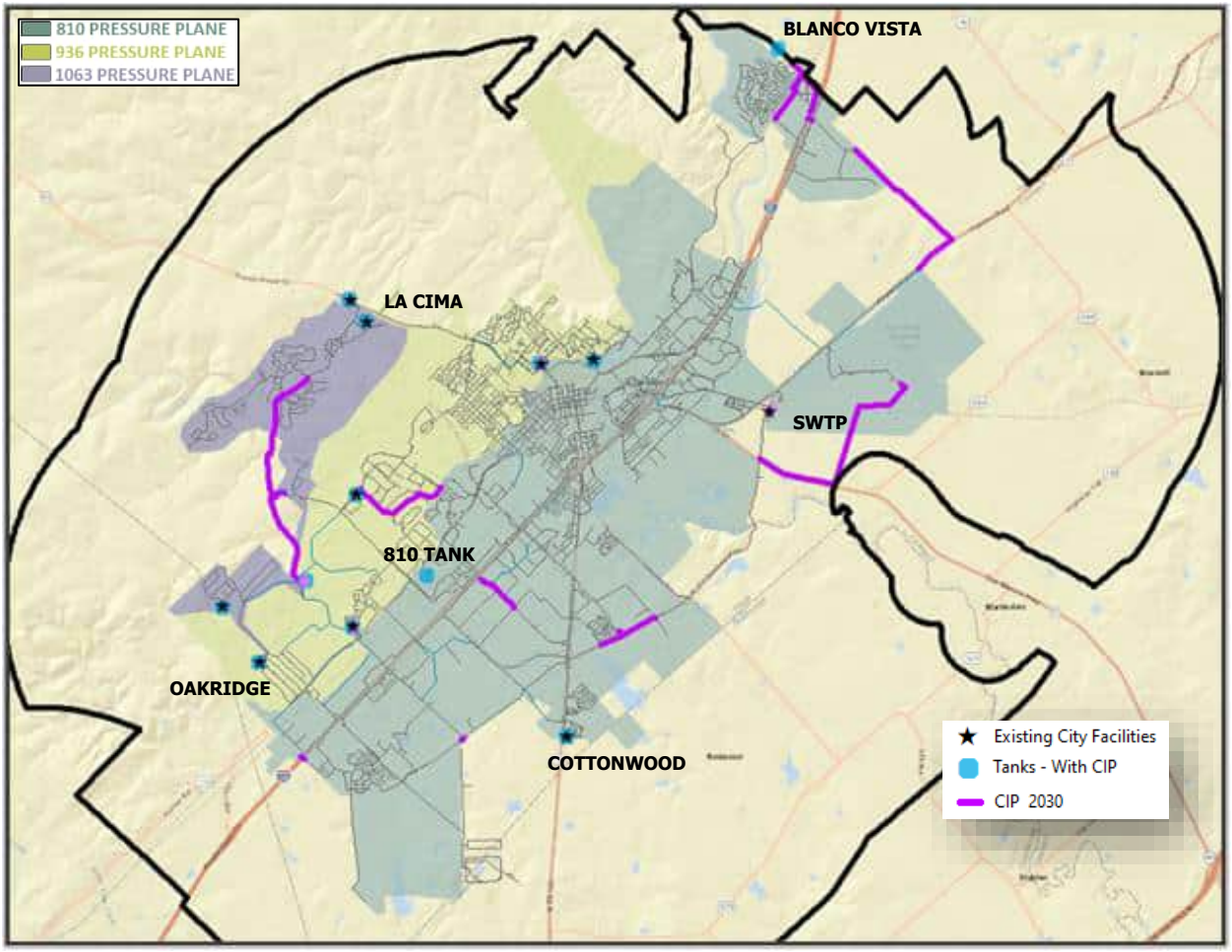


Figure 11: 2030 System Figure

6.3 2035 System Updates

Between 2030 and 2035, the population growth rate is projected to slow down as compared with the previous decade. Furthermore, much of the major CIP needs to support the ultimate planning horizon of 2035 will have been completed by 2030. As a result, the capital projects planned for completion between 2030 and 2035 are mostly small diameter pipe upgrades with only a few larger diameter pipeline segments remaining for completion. The completion of the 16 in. along Old Bastrop and connection to the dead end at the southeast end of Centerpoint Rd. will support Gaslamp as their projections increase from 1.0 MGD to 3.5 MGD. The key projects for the year 2035 include the following:

- Completion of the upgrades along Old Bastrop Road (Centerpoint to Rattler Rd.),
- Upgrade small diameter lines to 16 in. diameter along northbound IH-35 frontage road, south of downtown.
- New 1,100 gpm groundwater well at Comanche pump station.

Operationally, the distribution system will function much like it does in 2030 with increased flow from the Blanco Vista EST as Phase II of the ARWA groundwater becomes available. All developments presented in Table 6 and Table 7 are expected to be fully built out by this time frame.

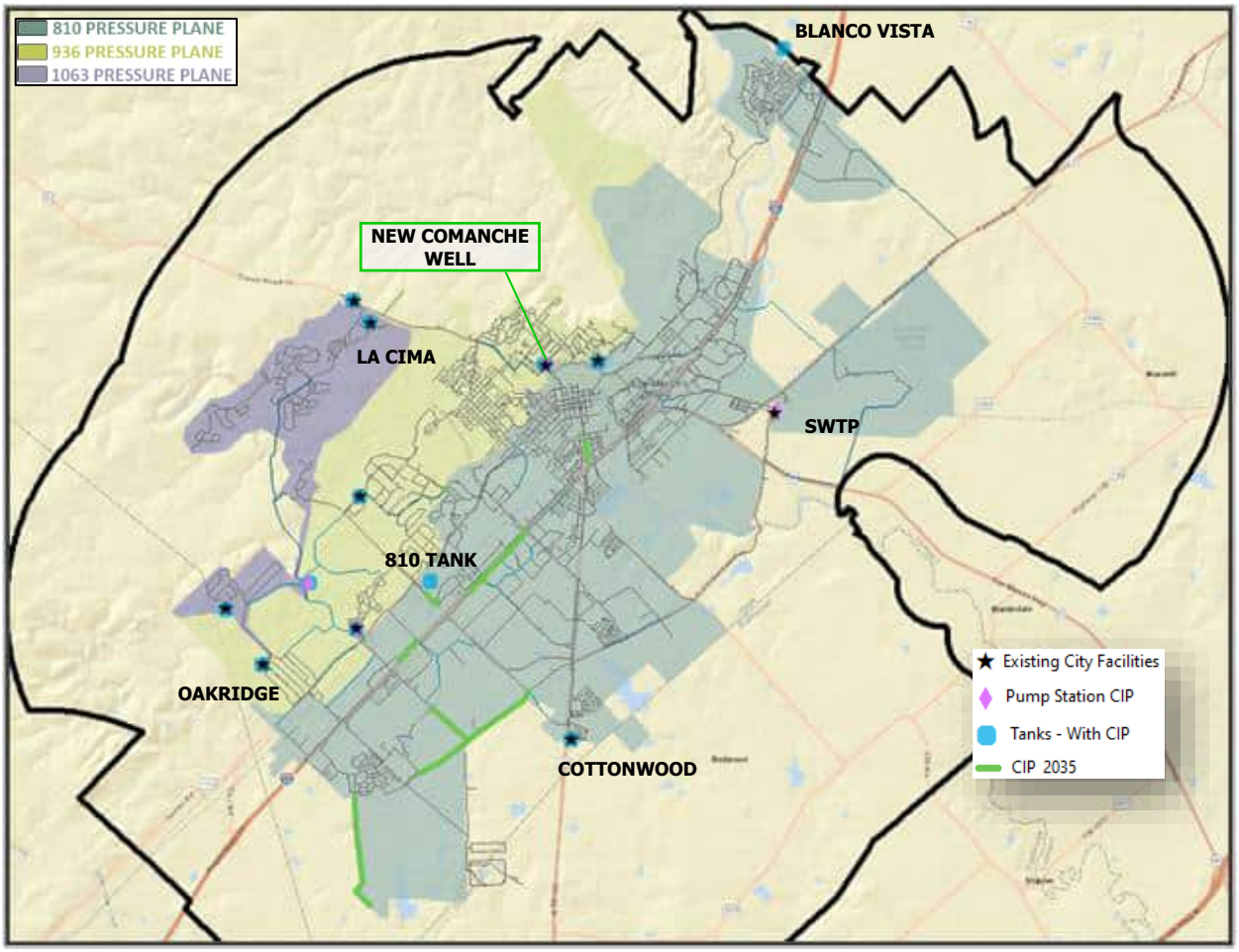


Figure 12: 2035 System Figure

6.4 Future Regulatory Evaluation

This section discusses the regulatory requirements applicable to the City's public water system with respect to water supply, storage, and pumping capacity using projected number of connections and estimated population served.

Water Supply

Assuming that the approved ACR variance of 0.32 gpm/connection applies to future conditions, the City will meet this ACR under the projected future 2035 scenario, with the proposed improvements, as shown in Table 13.

Table 13: Alternative Capacity Requirements – 2035

Water Supply	Total Production (gpm)
Treated Surface Water	6,250
Ground Water Pumps	
Spring Lake Well	6,360
Comanche Well	2,700
Soyars Well	400
McCarty Well	400
Oakridge Well	-
Kingswood Well	200
Crystal Clear	390
Future Well (Comanche)	1,100
ARWA Delivery	7,935
CRWA Share	833
Total	26,768
Estimated Number of Connections (2035)	48,850
gpm / connection	**0.55**
Meets ACR (0.32 gpm / conn)	Yes

Water Storage

The total storage and storage per connection under proposed conditions (2035) are presented in

Table ***14***. By 2035, four proposed projects will provide additional storage for future years. A new 1.0 MG EST in the Blanco Vista neighborhood will receive water from the ARWA project and have an overflow elevation of 815-ft, delivering the water supply at a pressure just slightly higher than that of the 810 pressure plane. A 1.0 MG elevated storage tank at a hydraulic grade of 810-ft is recommended to serve the projected growth in the central region of the water serve area. The new EST will be built near the edge of the 810 / 936 pressure plane divide along McCarty Ln. Additionally, a 1.0 MG tank located on a hilltop

will provide elevated storage to the proposed Kissing Tree Development and surrounding area. And finally, a new 2.0 MG GST at SWTP will serve as an additional delivery point for the ARWA water supply.

Pumping Capacity

As mentioned earlier, the TCEQ requirements for pumping are dependent upon available elevated storage. Table 15 displays the future pumping facility information compared to the peak hour demands for each pressure plane.

As can be seen in Tables 14 and 15, the City has adequate planned pumping capacity to meet the TCEQ requirements only if the potable water use by the Gaslamp commercial development does not exceed 3.5 MGD.

Table 14: Storage Tanks and Volumes – 2035

Storage Facilities by Pressure Plane	Proposed Active Head Range	Tank Style	2035				
			Projected Number of Connections	Required Total Storage[1] (MG)	Proposed Active Total Storage (MG)	Required Elevated Storage[2] (MG)	Proposed Active Elevated Storage (MG)
810-FT			**38,926**	**7.8**	**11.2**	**3.9**	**4.7**
SWTP Clearwells (x3)		Ground			5.0		
Spring Lake GST	610 - 636	Ground			1.5		
Comanche Standpipe	762 - 810	Elevated			0.7		0.7
Cottonwood Elevated Tank	771 - 810	Elevated			1.1		1.1
McCarty Standpipe	758 - 810	Elevated			0.3		0.3
Soyars Standpipe	742 - 805	Elevated			0.3		0.3
Blanco Vista EST	775-815	Elevated			1.2		1.2
POTENTIAL 810 EST	771 - 810	Elevated			1.1		1.1
936-FT			**6,591**	**1.3**	**3.2**	**0.7**	**1.9**
Comanche Standpipe	762 - 810	Ground			0.7		
Soyars Standpipe	742 - 805	Ground			0.3		
Oakridge GSTs (x2)	738.5 - 760	Ground			0.08		
McCarty Standpipe	758 - 810	Ground			0.3		
Ranch Road 12	905 - 936	Elevated			1.0		1.0
Willow Creek EST[4]	812-842	Elevated					
Willow Creek GST[4]	660-624	Ground					
Kissing Tree (Future Tank)	870 - 936	Elevated			0.9		0.9
1063-FT			**3,333**	**0.7**	**2.4**	**0.3**	**0.5**
Ranch Road 12	905 - 936	Ground			1.0		
Kissing Tree (Future Tank)	870 - 936	Ground			0.9		
Kingswood GST	884 - 900	Ground			0.04		
La Cima	1025 - 1063	Elevated			0.5		0.5
System Total[3]			**48,850**	**9.8**	**30.6**	**4.9**	**14.1**
(TAC 30, Ch. D, §290.45)							

[1] Required Total Storage in Plane is 200 gallons per connection. (TAC 30, Ch. D, §290.45)

[2] Required Elevated Storage in Plane is 100 gallons per connection when connections exceed 2,500. (TAC 30, Ch. D, §290.45)

[3] Total system storage only accounts for each tank once, although in a few cases a tank may serve two pressure planes at once.

[4] Willow Creek infrastructure inherited from the central Crystal Clear service area - not used in evaluation.

Table 15: Pumping Stations and Capacities – 2035

Pressure Plane	Pump Station	2035					
		Projected Number of Connections	Projected 2035 Average Annual Demand (gpm)	Projected 2035 Maximum Day Demand (gpm)	TCEQ Required Firm Capacity[1] (gpm)	Projected Total PS Capacity (gpm)	Projected Firm PS Capacity (gpm)
1063 (Kingswood, La Cima)	Kingswood	3,333	709	1,165	1,558	400	200
	Kissing Tree (Future)					3,200	1,600
	Ranch Road 12					3,600	2,400
	Total per Plane					**7,200**	**4,200**
936 (Mid-Range)	Comanche (Larger Pumps)	6,591	1,403	2,304	3,081	5,000	3,750
	Soyars					1,200	600
	McCarty					600	400
	Oakridge - Not Active					0	0
	Total per Plane					**6,800**	**4,750**
810 (SWTP)	SWTP HSPS (Add One Pump)	38,926	8,286	13,607	18,197	16,664	12,498
	CRWA Share (Future)					833	833
	Spring Lake					8,610	6,360
	Total per Plane					**26,107**	**19,691**
Total		**48,850**	**10,399**	**17,076**	**22,836**	-	-
(30TAC§290.45)							

[1] Based upon peak hourly demands. The calibration effort in the scope of the 2016 WMP describes how peak hourly demands were calculated.

7 Recommended Capital Improvements

The updated CIP list for the City is discussed in this section.

7.1 Development of Project List

Based on the modeled scenarios, a list of recommended capital improvement program projects (CIP List) was developed for the interval between each future target year. The CIP list presented below is inclusive of all projects which were recommended in the 2016 Water Master Plan Update, but these projects have been renumbered for purposes of this update. Those projects which have already been implemented in the City's system have been removed from the list and incorporated into the 2019 ("Existing") model scenario.

The projects listed in the table below are required based on the model results for the future year scenarios and compliance with the system criteria listed in Chapter 3. Additional projects were also identified for the following reasons:

- Improvement of water age / quality.
- Improvement of hydraulic efficiency (elimination of dead-ends, creation of looped systems).
- Upgrading small-diameter connections (less than 6-in diameter pipes).

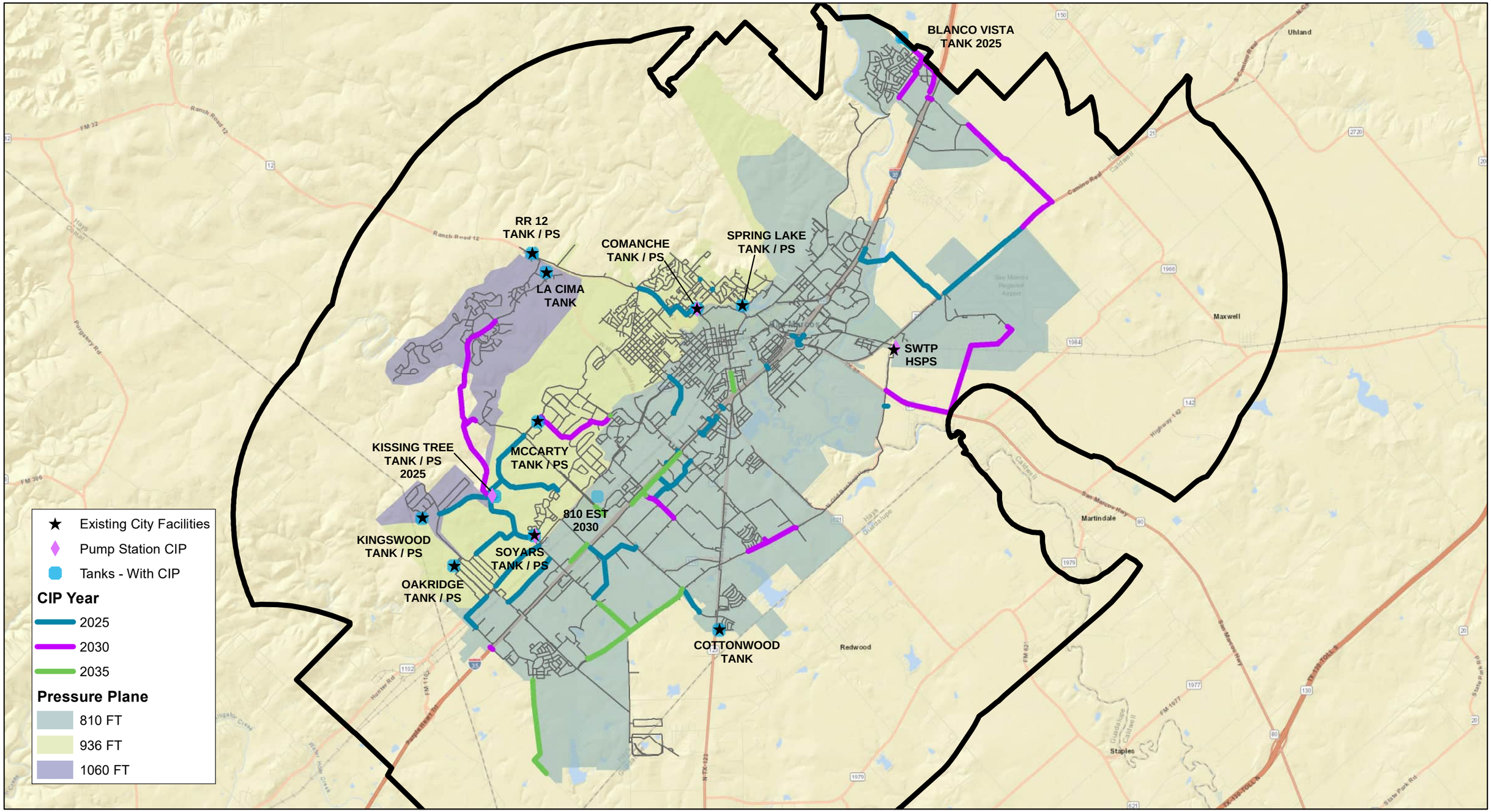
CIP projects which are new to the 2020 Water Master Plan or have moved up in the proposed implementation schedule are designated with an asterisk (*) in the left hand column. CIP projects which have the suffix (D) in their CIP number are developer driven and are not the City's responsibility for funding.

Table 16: Proposed CIP Projects

NEW Project	CIP Number	*2016 CIP Number*	CIP Year	Project Name
	1	1	2025	Replace Comanche Pumps
	2	3	2025	Replace Soyars Pumps
	3	6	2025	Hunter Rd Parallel
	4	-	2025	Southwest 810' Plane Loop
	5	8	2025	Stagecoach Trail Extension
	6	-	2025	Rattler Road Loop
	7	14	2025	South Hunter Rd Loop
*	**8**	-	2025	Patricia and Sunset Acres Upgrades
	9	-	2025	Leah Ave Extension
	10	16	2025	Upgrade IH-35 Crossings
	11	-	2025	Railroad Crossing and Upgrades near the Conn's shopping center.
	12	-	2025	Gaslamp Feed
	13	17	2025	Airport Extension

NEW Project	CIP Number	*2016 CIP Number*	CIP Year	Project Name
*	**14**	-	2025	Blanco Vista EST
*	**15**	37	2025	Add SWTP Pump
*	**16**	-	2025	12 in. Connection for CRWA Share
	17 (D)	18	2025	Kissing Tree Tank
	18 (D)			Kissing Tree PS
	19 (D)	21	2025	Kissing Tree Loop - Phase 2a
	20 (D)			
	21 (D)	22	2025	Kissing Tree Loop - Phase 2b
	22	23	2025	Kissing Tree - Kingswood Line
	23	24	2025	Kissing Tree - Deerwood Line
	24 (D)	25	2025	Kissing Tree - McCarty Line
	25	28	2025	Airport Loop
*	**26**	20	2025	Parallel Comanche Outlet Main *(See Note 1)*
	27	26	2030	Kissing Tree - La Cima Loop (16 in. and 24 in.) *(See Note 1)*
	28			
	29	27	2030	McCarty Tank Fill / Drain Line to 810 Plane
	30	29	2030	US 80 Loop
	31	31	2030	Clovis Barker Upgrade
*	**32**	-	2030	Trace Development Connection
*	**33**	-	2030	Redwood to HWY 123
*	**34**	-	2030	North Side Connection
*	**35**	-	2030	Post Rd Connection
*	**36**	-	2030	Potential 810 EST along McCarty Ln.
*	**37**	19	2035	Add Well Capacity at Comanche
*	**38**	30	2035	Old Bastrop Extension 2
*	**39**	32	2035	Centerpoint Extension
*	**40**	34	2035	Francis Harris Extension
*	**41**	35	2035	South LBJ Upgrade
*	**42**	36	2035	McCarty Connection
	43	38	2035	Old Bastrop Extension 3
	44	39	2035	Tanger Loop
	45	-	2035	IH 35 Frontage Upgrades

Note 1: In 2025, it is proposed that the existing 16 in. discharge line from the Comanche pump station be paralleled with another 16 in. (CIP 36) to send more flow up to the RR 12 tank. The 16 in. line connecting La Cima to the Kissing Tree pump station is proposed to be installed prior to 2030 (CIP 25/26). Kingswood will benefit from the pressure maintenance of the La Cima EST and the new Kissing Tree pump station will be able to send flow to La Cima for their demands. Both of these projects are aiding the new 1063 plane with additional flow as La Cima continues to develop. The projects are not interchangeable, but the model results show that a paralleled discharge line from Comanche will help in 2025 and 2030 to meet the La Cima demands if the 16 in. line from Kissing Tree to La Cima is not installed until 2030. The new discharge line project should be coordinated with other upgrade projects along the north side of Ranch Road 12 between Holland St. and Craddock Ave.



PLUMMER

City of San Marcos: Water Master Plan Update
Capital Improvement Projects: 2025, 2030, and 2035
04/06/2020

THE CITY OF SAN MARCOS

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7.2 Infrastructure Renewal and Maintenance Projects

The City has developed and continues to maintain a water system risk model which assesses the condition of each pipe in the system based on two criteria: break history for the last five years and the remaining useful life based on install date and pipe material. The consequence of failure for each of the system's pipes accounts for the role of the pipe within the network (minor line, major line, or transmission line), the proximity to roadways, and whether or not it is located in an environmentally sensitive area. The City's risk model calculates a score for each pipe and identifies the pipe's risk of failure as "Low", "Moderate", or "High".

According to the risk model developed by the City, there are two pipelines which are at high risk of failure. These two pipes are recommended to be budgeted for replacement with the other 2025 CIP projects. The risk model should continue to be updated as additional data is collected. However, at this time, based on current risk scores, it is recommended that the City budget for and replace nine pipelines (in addition to the two above) by the year 2030. It is also recommended that the City closely monitor pipe WL21790 (pipe #11 in table below). This 24 in. diameter pipe is relatively young but has a high consequence of failure resulting in a moderate risk ranking.

Table 17: Maintenance CIP Projects

Pipe Number	CIP Year	Original Install Year	Material	Diameter (inches)	Location Description
1	2025	2002	PVC	2	Riverside Dr.
2	2025	1975	UNKNOWN	6	Staples Rd.
3	2030	1980	PVC	2	Briarwood Dr.
4	2030	1974	PVC	1	Roosevelt St. Neighborhood
5	2030	1974	PVC	2	Roosevelt St. Neighborhood
6	2030	1974	PVC	2	Roosevelt St. Neighborhood
7	2030	1945	PVC	2	Harvey St.
8	2030	1958	PVC	2	Panorama Dr.
9	2030	1974	PVC	2	Roosevelt St. Neighborhood
10	2030	1910	UNKNOWN	6 / 8	Hopkins St.
11	Monitor	2007	PVC	24	McCarty East

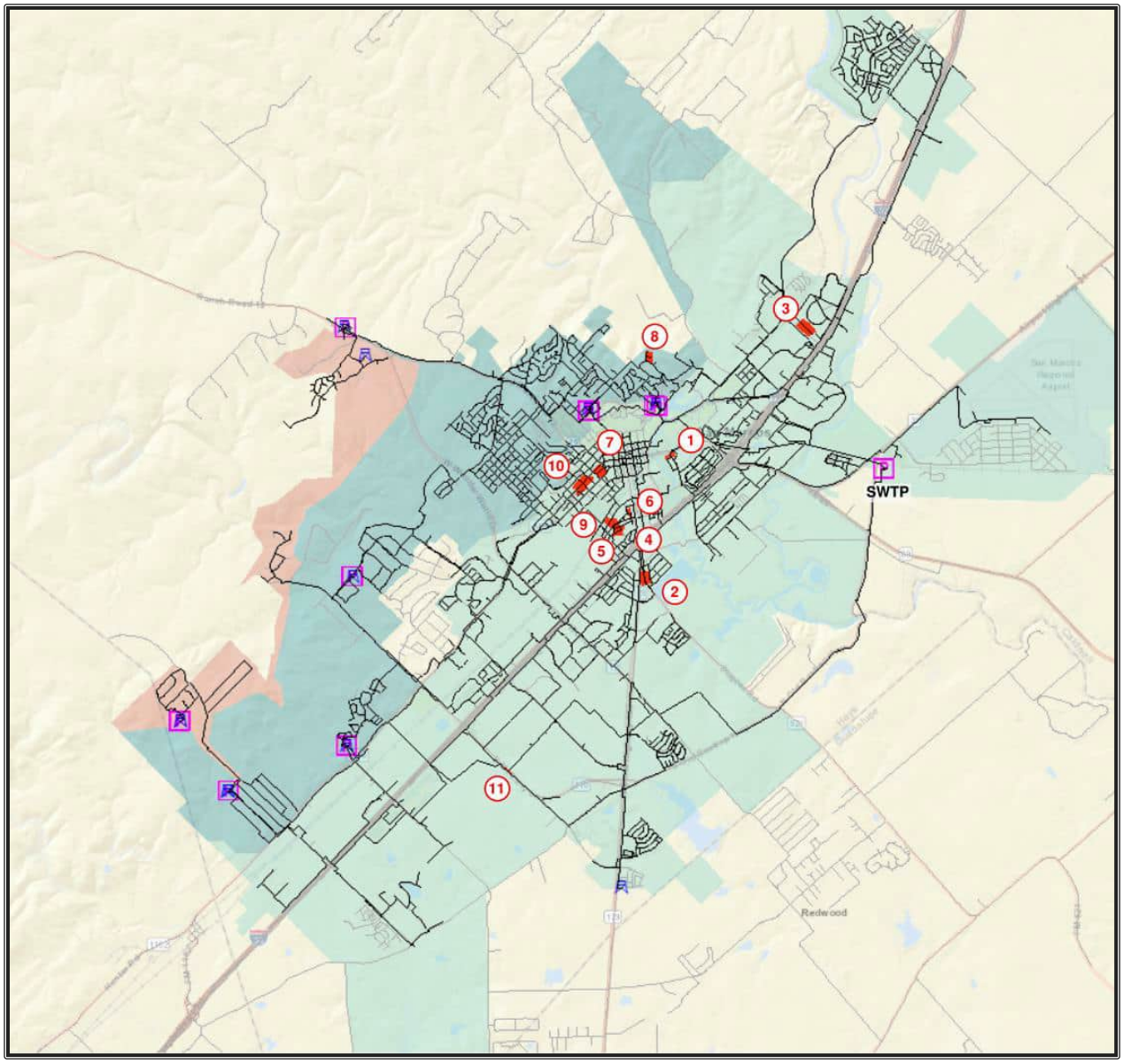


Figure 13: Recommended Pipeline Maintenance Projects

7.3 Opinion of Probable Construction Costs

A summary of the estimated construction costs of the CIP projects is presented below. Detailed cost estimates for each project are included in Appendix E.

In developing the above CIP cost opinions, the Texas Water Development Board's (TWDB) Unified Costing Model (UCM) was used as a guide for pipelines and pump stations. However, when these values were compared to recent bid tabulations for the City of San Marcos, the bids suggested that the UCM values should be adjusted. The cost adjustment was determined to be a factor of 1.48 for all pipelines. New pump stations were estimated using UCM values as a function of required horsepower (HP). All costs based on

the UCM values were then updated from the last UCM publication in March 2012 to November 2019 dollars using Engineering News Record (ENR) construction cost index (CCI) values.

For pipelines, cost opinions per linear foot were determined by assuming substrate type in the area (rock or soil) as well as the development density along the developed route (urban or rural), and then looking up the value for the proposed diameter in the appropriate table in the UCM. The UCM cost was then multiplied by the City's adjustment factor of 1.48 and then brought to present value using the ENR CCI.

For new pump stations, required HP was determined and recent bid tabs were used to develop cost opinions for stations with HP values from 80 to 200. Stations with HP values outside this range were interpolated from the UCM table for new pump stations. Costs were then brought to present value using the ENR CCI.

For tanks, recent bid tabulations, detailed cost opinions, and UCM values were compared to estimated costs for new tanks. Costs were then brought to present value using the ENR CCI.

Land costs associated with easements were estimated using recent Hays County appraisal values where available. If no appraisal values were available in the area, best engineering judgement was used to estimate land costs.

Table 18: 2025 CIP Cost Opinions

CIP Number	Project Name	Description	Dia. (in)	Estimated Total Cost
1	Replace Comanche Pumps	New Pumps at Comanche to fill RR 12 & 50 LF 16 in. yard piping	16 -	$ 2,686,000
2	Replace Soyars Pumps	Replace Soyars pumps to fill the 936 Pressure Plane and Kissing Tree	-	$ 1,212,000
3	Hunter Rd Parallel	Hunter Road from Quail Run to Centerpoint (near Soyars) Extension in 936 Plane, serving the south side of Hunter Rd customers	12	$ 684,000
4	Southwest 810' Plane Loop	Connect Centerpoint to Transportation Way in the 810 plane	12	$ 662,000
5	Stagecoach Trail Extension	Extend line from end of Stagecoach to intersection of Belvin and Bishop (existing 12 in. tie in)	12	$ 523,000
		Stream crossing – Bore	12	
6	Rattler Road Loop	Complete 12 in. loop around the high school on Rattler Rd. and build ~500 LF of 16 in. to the southwest along Old Bastrop Ln.	12	$ 263,000
7	South Hunter Rd Loop	Connect existing 12 in. (on 810 plane) in Hunter Rd to 12 in. in Industrial Fork Rd.	12	$ 507,000
8	Patricia and Sunset Acres	Upsize 2 in. line along Del Sol Dr and 8 in. line along Patricia Dr. to each be 12	8	$ 342,000

CIP Number	Project Name	Description	Dia. (in)	Estimated Total Cost
		in. diameter as a part of the Sunset Acres drainage project	12	
9	Leah Ave Extension	Install 12 in. to connect Leah Ave between Cottonwood Pkwy and Clovis Barker	12	$ 859,000
10	Upgrade IH-35 Crossings	Upgrade 6 or 7 existing water line crossings to 16 in. Between McCarty & Aquarena Springs Rd.	12	$ 1,867,000
			16	
11	Railroad Crossing and Upgrades near the Conn's shopping center	Upgrade IH 35 crossing near the railroad crossing and upsize the 8 in./10 in. lines to the east of IH 35	12	$ 696,000
		IH-35 Crossing Section	12	
12	Gaslamp Feed	Install 12 in. from McCarty behind the Premium outlets to the 24 in. to feed the industrial development area and 18 in. line to serve Gaslamp	12	$ 319,000
13	Airport Extension	Extend 12 in. northeast along HWY 21	12	$ 968,000
14	Blanco Vista EST	Build 1.0 MG elevated storage tank and 24 in. outlet line to Blanco Vista Blvd	24	$ 586,000
				$ 4,493,000
15	Add SWTP Pump	New Pump at SWTP Pump Station	-	$ 401,000
16	12 in. Connection for CRWA Share	12 in. x 30 in. connection on the 30 in. transmission main, just south of the WTP	12	$ 30,000
17 (D)	Kissing Tree Tank	New 0.50 MG Elevated Storage for 936 pressure plane	-	$ 2,247,000
18 (D)	Kissing Tree PS	Pumps to fill La Cima Tank and deliver to 1063 pressure plane	12	$ 2,729,000
			16	$ 172,000
19 (D)	Kissing Tree Loop - Phase 2a	Central Loop in Development Phase I	16	$ 1,521,000
20 (D)			24	
21 (D)	Kissing Tree Loop - Phase 2b	Central Loop in Development Phase 2	12	$ 1,176,000
			16	
22	Kissing Tree - Kingswood Line	Connect Kissing Tree to Kingswood at Lazy Ln (include flow control valve)	12	$ 414,000
23	Kissing Tree - Deerwood Line	Connect Kissing Tree Loop to Trails End	12	$ 417,000
24 (D)	Kissing Tree - McCarty Line	Connect Kissing Tree Loop to 16 in. KT line from McCarty Ln.	12	$ 715,000
			16	
25	Airport Loop	Connect IH-35 to HWY 21 along Harris Hill Rd, creating a loop for the northeast service area	12	$ 977,000
26	Parallel Comanche Outlet Main	Parallel of existing 20 in./16 in. Comanche PS to Craddock Ave. & RR12	16	$ 1,669,000

Table 19: 2030 CIP Cost Opinions

CIP Number	Project Name	Description	Dia. (in)	Estimated Total Cost
27	Kissing Tree - La Cima Loop	Kissing Tree Tank to La Cima PS via new line to and through La Cima development. Also connect this loop to existing neighborhood (Estates of San Marcos) with an 8 in. new line along W. McCarty Ln. New 8 in. needs PRV to reduce pressure to 95 psi.	8	$ 3,016,000
28			12	
			16	
29	McCarty Tank Fill/Drain Line	Connect McCarty Standpipe to 810 pressure plane via Stagecoach	12	$ 1,581,000
30	US 80 Loop	Extend 12 in. line from existing 30 in. along SH 80 to edge of CCN, then north along property boundaries to connect to dead end at airport.	12	$ 1,907,000
31	Clovis Barker Upgrade	Upgraded lines along Clovis Barker to 16 in. to tie into existing 24 in. Also upgraded lines along IH-35 to 16 in. to tie into existing 16 in. lines.	16	$ 622,000
32	Trace Dev. Connection	Connect development on the south end to 16 in. along IH 35	16	$ 208,000
33	Redwood to HWY 123	Connect the 16 in. along Old Bastrop Rd to the East to the 18 in. line north of Cottonwood and complete 12 in. line on Redwood south to connect at Old Bastrop.	12	$ 547,000
34	North Side Connection	Add 12 in. line to move ARWA water from the Blanco Vista Tank to the east side of IH 35 (follow Yarrington extension).	8	$ 3,877,000
			12	
			16	
35	Post Rd Connection	Close loop along north end of Post Rd., south of Champions Blvd	12	$ 354,000
36	Potential 810 Elevated Storage Tank	New elevated storage tank with overflow elevation of 810 to be installed along McCarty Ln. near the top of the 810 pressure plane.	-	$ 4,493,000

Table 20: 2035 CIP Cost Opinions

CIP Number	Project Name	Description	Dia. (in)	Estimated Total Cost
37	Add Well Capacity	Add groundwater well at Comanche.	-	$ 1,234,000
38	Old Bastrop Extension 2	Rattler to Centerpoint Extension along Old Bastrop Highway	16	$ 1,303,000
39	Centerpoint Extension	Install 16 in. perpendicular to Old Bastrop to 12 in. Existing Line	12 16	$ 565,000
40	Francis Harris Extension	Extend 8 in. line from existing terminus of 12 in. line in Old Bastrop to Francis Harris, then along Francis Harris to power plant.	8	$ 748,000
41	South LBJ Upgrade	Upgrade small diameter line in S. LBJ from E. Grove St. to IH-35 Crossing	12	$ 250,000
42	McCarty Connection	Extend existing 12 in. line further south along E. McCarty Lane toward IH-35 to connect to future growth area.	12	$ 182,000
43	Old Bastrop Extension 3	Centerpoint to Horace Howard Extension along Old Bastrop Highway, Include connection to existing line on Horace Howard Dr.	12	$ 463,000
44	Tanger Loop	Connect existing 24 in. to end of proposed 12 in. developer line along IH-35 north of Centerpoint (Behind Bill Miller's)	12	$ 419,000
45	IH 35 Frontage Upgrades	Upgrade IH 35 lines along northbound side to 16 in. pipes from tan warehouse building north of McCarty to the northeast until Wonder World Dr.	16	$ 1,388,000

8 Recommended Supply Plan

With the new supply from the regional ARWA project, the City will have four main sources of potable water for their customers. The following recommendation is based on minimizing operation and maintenance costs of running the HSPS at the SWTP and preserving the City's groundwater rights.

Since the ARWA supply is negotiated as a take or pay contract between the City and ARWA and the water source is already delivered at the required pressure, the City will not be paying power costs associated with running the SWTP and HSPS for this supply volume. The ARWA source should be the first to be utilized.

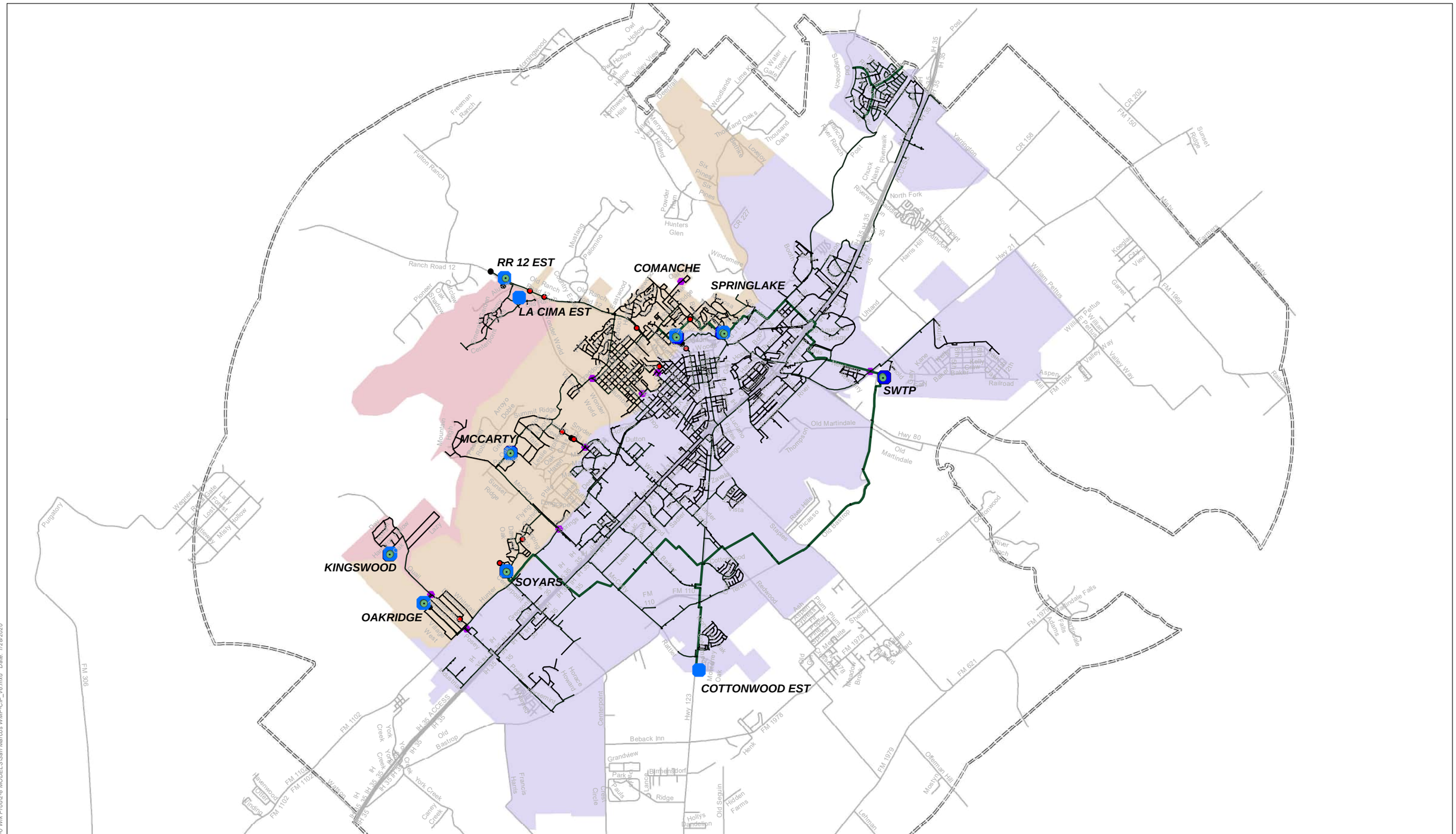
1. Take full ARWA allocation through the new Blanco Vista EST for base flow.
2. Utilize full share of Hays-Caldwell WTP capacity to supplement base flow.
3. Use treated surface water from the HSPS at the SWTP to fill tanks during peak flows.
4. Exercise wells as needed to maintain Edwards Aquifer rights.

Table 21: Projected Supply and Demands

	Average Day Demand Estimate (MGD)	Peak Demand (MGD)	ARWA Supply (MGD)	SWTP Supply (MGD)	H-C WTP Share (MGD)	Groundwater Potential (MGD)	Total Supply Provided (MGD)
2025	10.4	22.8	4.8	9.0	1.2	14.8	**29.8**
2030	11.7	25.7	4.8	9.0	1.2	14.8	**29.8**
2035	15.0	32.9	11.4	9.0	1.2	16.4	**38.0**

APPENDIX A

EXISTING SYSTEM MODEL RESULTS



WATER STORAGE AND PUMPING
WATER STORAGE
PRESSURE REDUCING VALVE
MIN PRESSURE LESS THAN 35 PSI
MIN PRESSURE LESS THAN 25 PSI

CITY OF SAN MARCOS
WATER MASTER PLAN UPDATE

EXHIBIT A-1: 2019 AVERAGE DEMAND
EPS RESULTS: MINIMUM PRESSURE

PLUMMER

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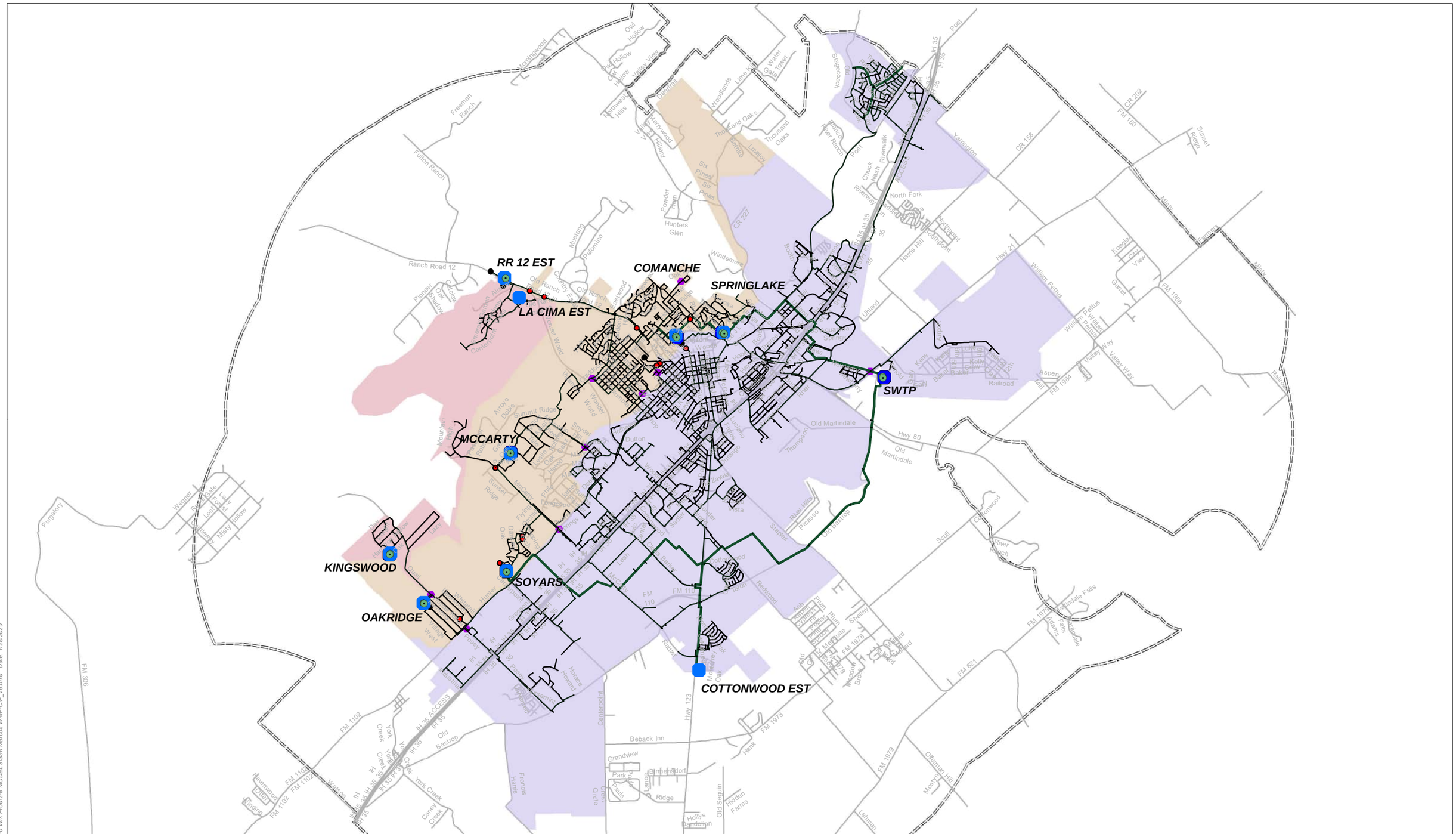

CITY OF SAN MARCOS
WATER MASTER PLAN UPDATE

EXHIBIT A-2: 2019 MAXIMUM DEMAND
EPS RESULTS: MINIMUM PRESSURE

PLUMMER

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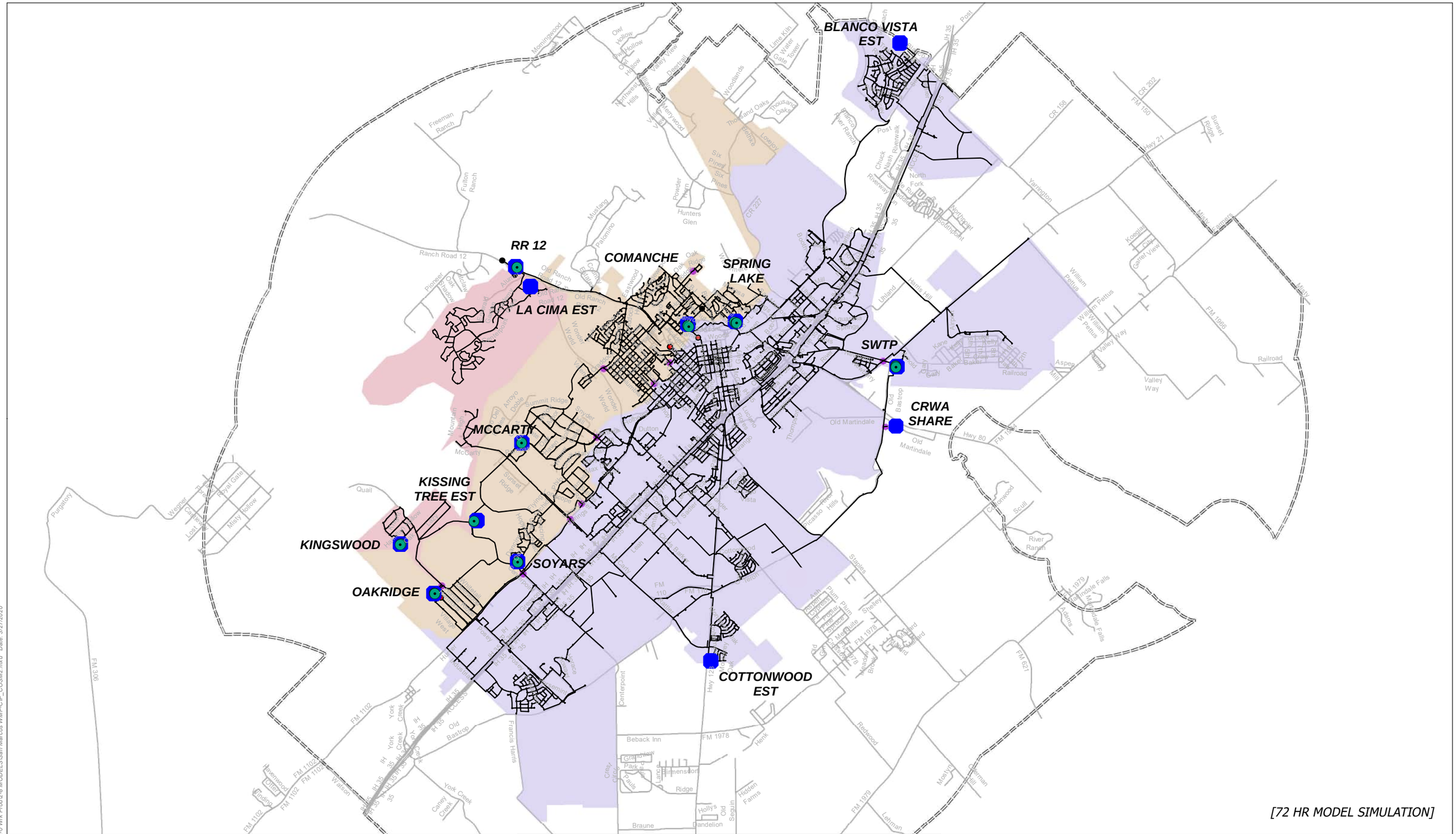
APPENDIX B

2025 SYSTEM MODEL RESULTS



[72 HR MODEL SIMULATION]

CITY OF SAN MARCOS
WATER MASTER PLAN UPDATE

EXHIBIT B-1: 2025 AVERAGE DEMAND
EPS RESULTS: MINIMUM PRESSURE

PLUMMER

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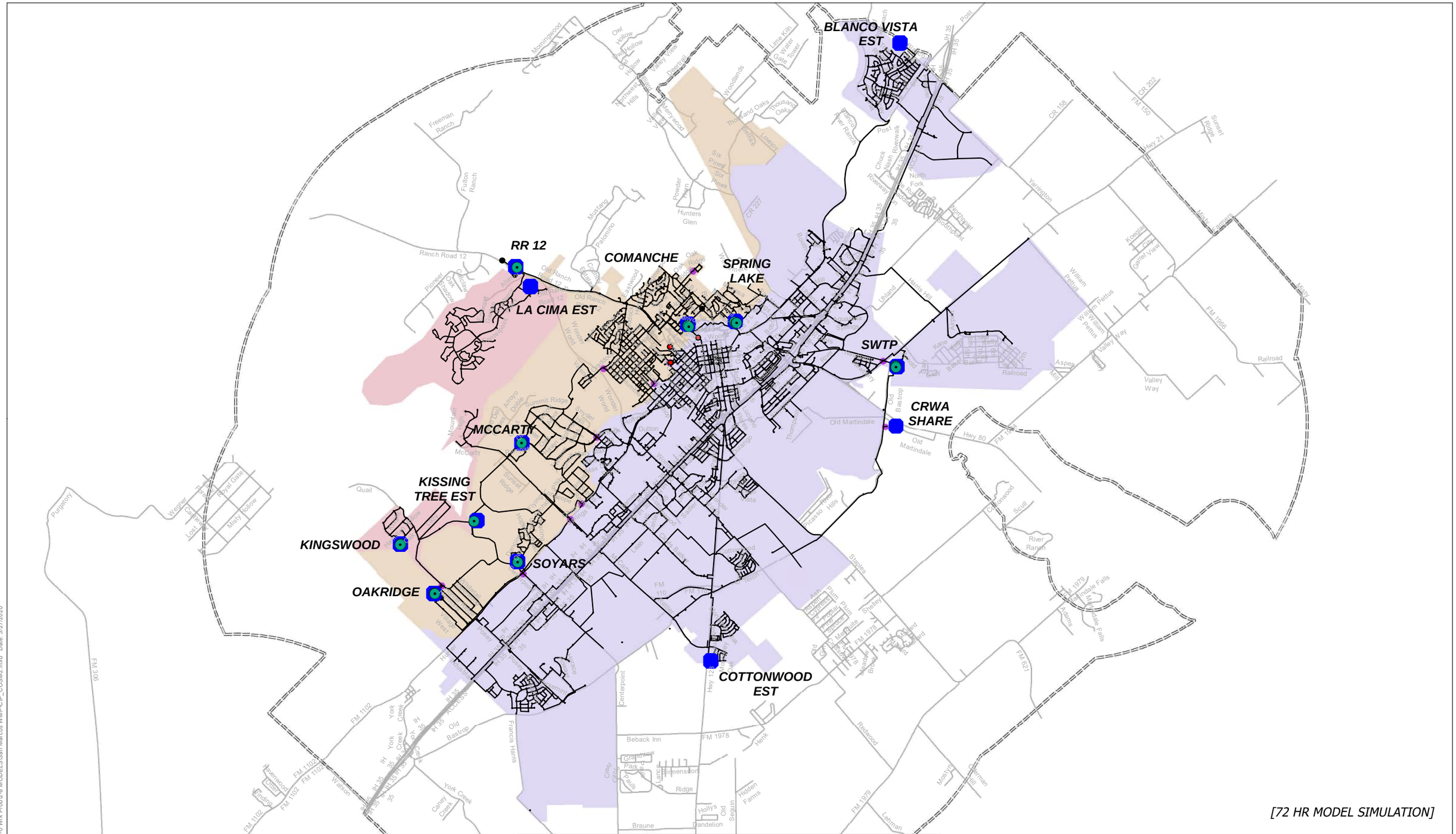

CITY OF SAN MARCOS
WATER MASTER PLAN UPDATE

EXHIBIT B-2: 2025 MAXIMUM DEMAND
EPS RESULTS: MINIMUM PRESSURE

PLUMMER

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BLANCO VISTA EST
RR 12
COMANCHE
SPRING LAKE
LA CIMA EST
SWTP
CRWA SHARE
MCCARTY
KISSING TREE EST
KINGSWOOD
SOYARS
OAKRIDGE
COTTONWOOD EST

[300 HR MODEL SIMULATION]

WATER STORAGE AND PUMPING
WATER STORAGE
PRESSURE REDUCING VALVE
AVG WATER AGE BETWEEN 120 HOURS AND 240 HOURS
AVG WATER AGE GREATER THAN 240 HOURS

CITY OF SAN MARCOS
WATER MASTER PLAN UPDATE

EXHIBIT B-3: 2025 AVERAGE DEMAND
EPS RESULTS: AVERAGE WATER AGE

PLUMMER

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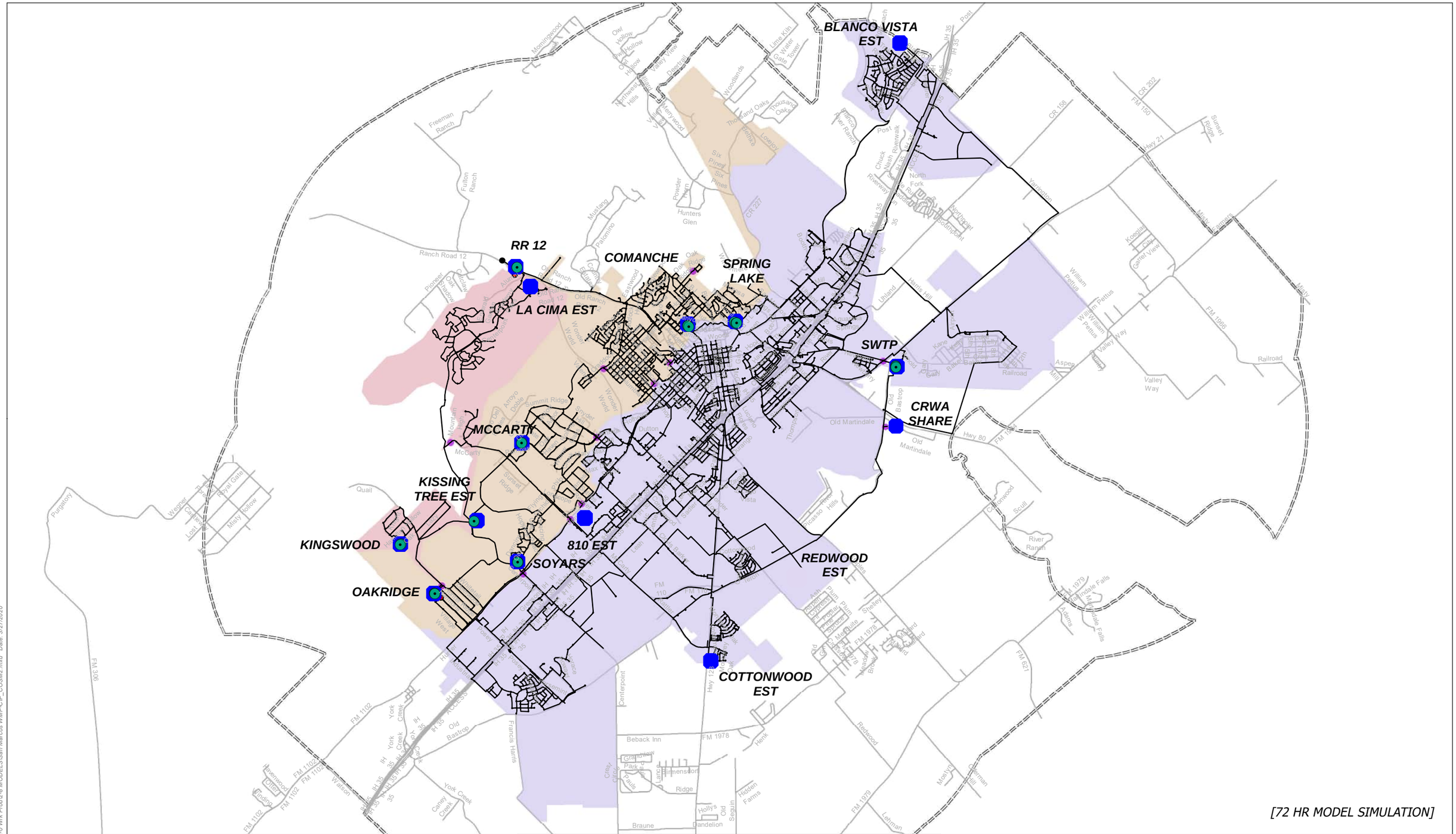
APPENDIX C

2030 SYSTEM MODEL RESULTS



[72 HR MODEL SIMULATION]

CITY OF SAN MARCOS
WATER MASTER PLAN UPDATE

EXHIBIT C-1: 2030 AVERAGE DEMAND
EPS RESULTS: MINIMUM PRESSURE

PLUMMER

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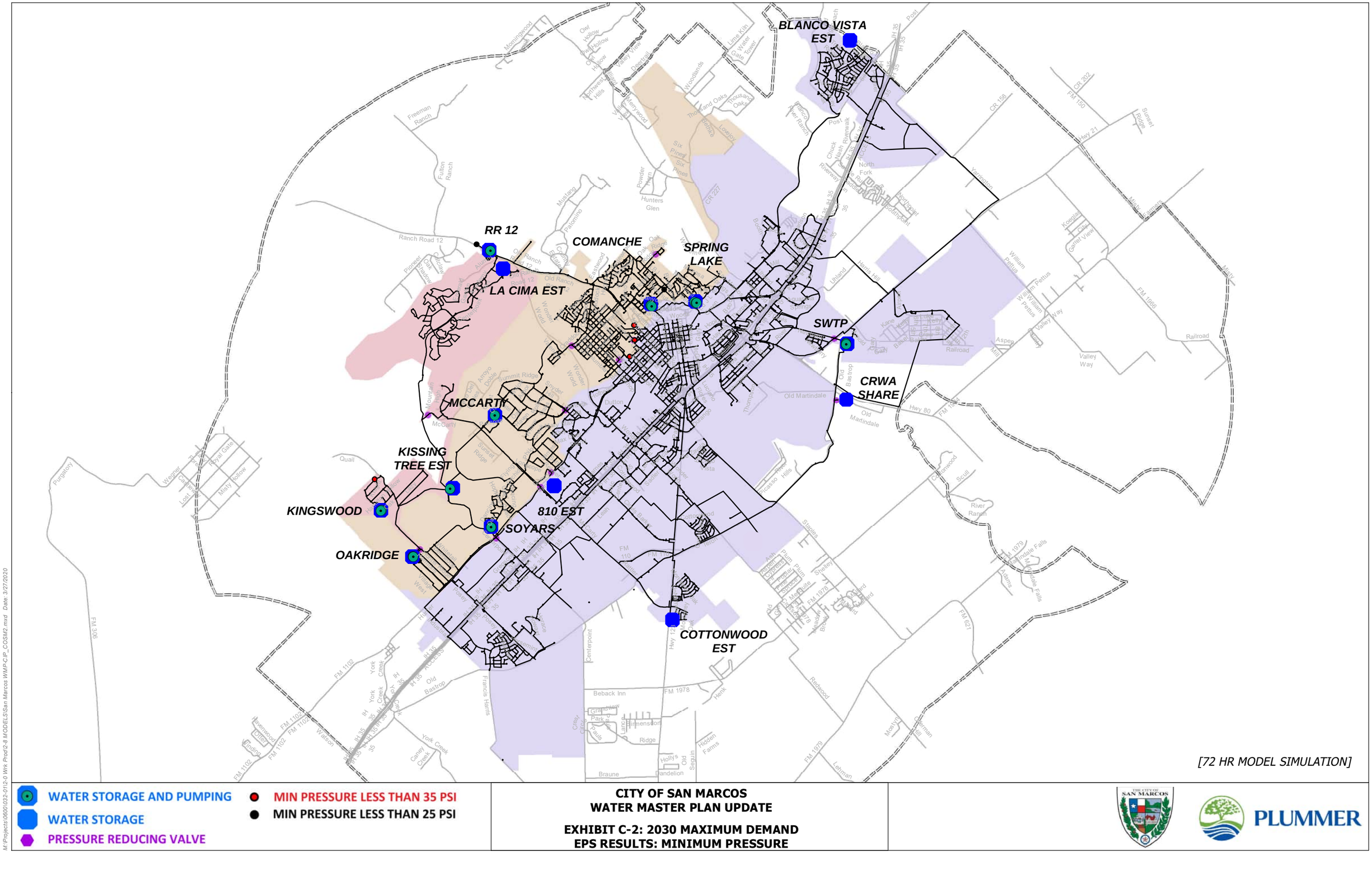

CITY OF SAN MARCOS
WATER MASTER PLAN UPDATE

EXHIBIT C-2: 2030 MAXIMUM DEMAND
EPS RESULTS: MINIMUM PRESSURE

PLUMMER

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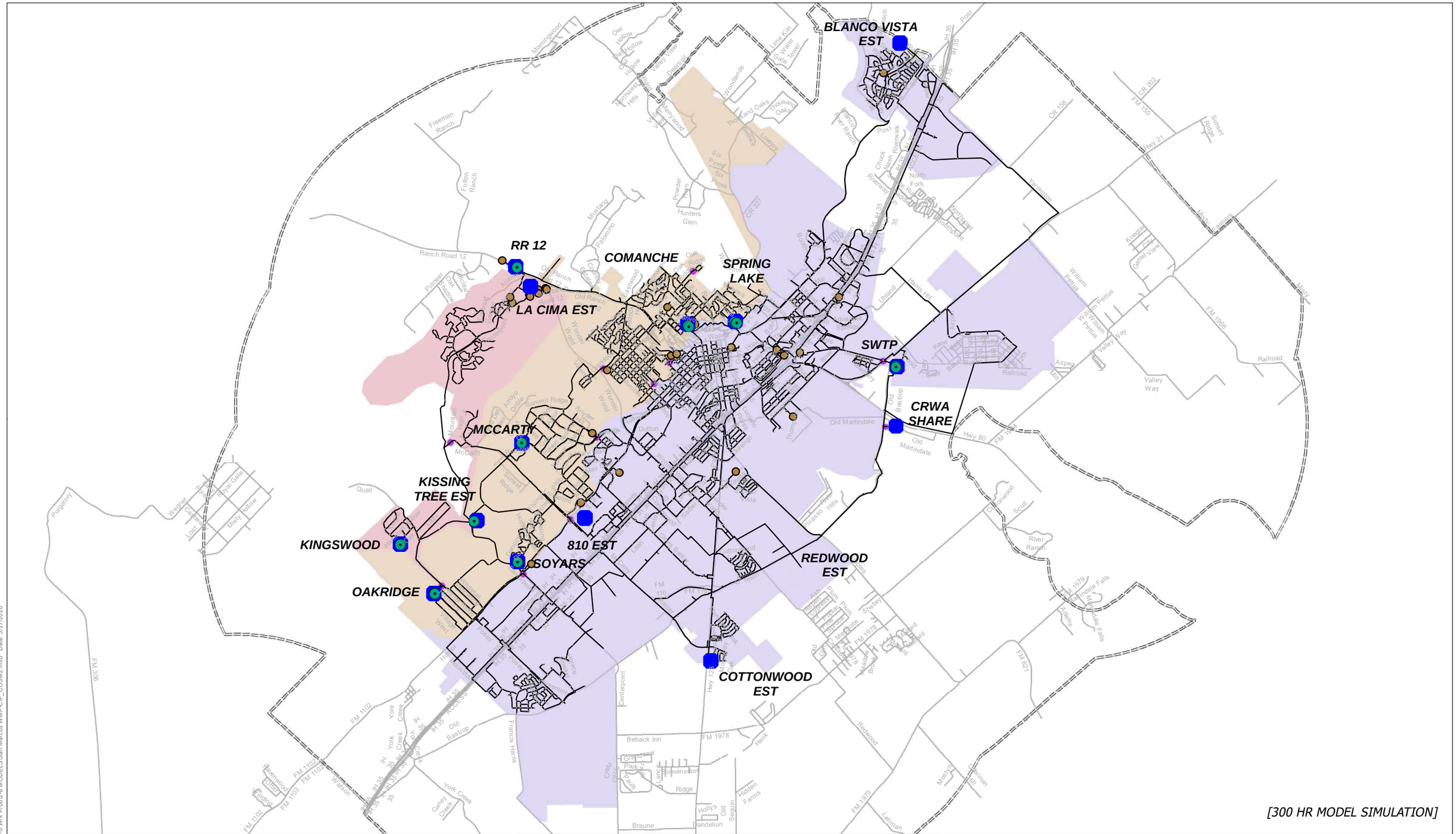

[300 HR MODEL SIMULATION]

CITY OF SAN MARCOS
WATER MASTER PLAN UPDATE

EXHIBIT C-3: 2030 AVERAGE DEMAND
EPS RESULTS: AVERAGE WATER AGE

PLUMMER

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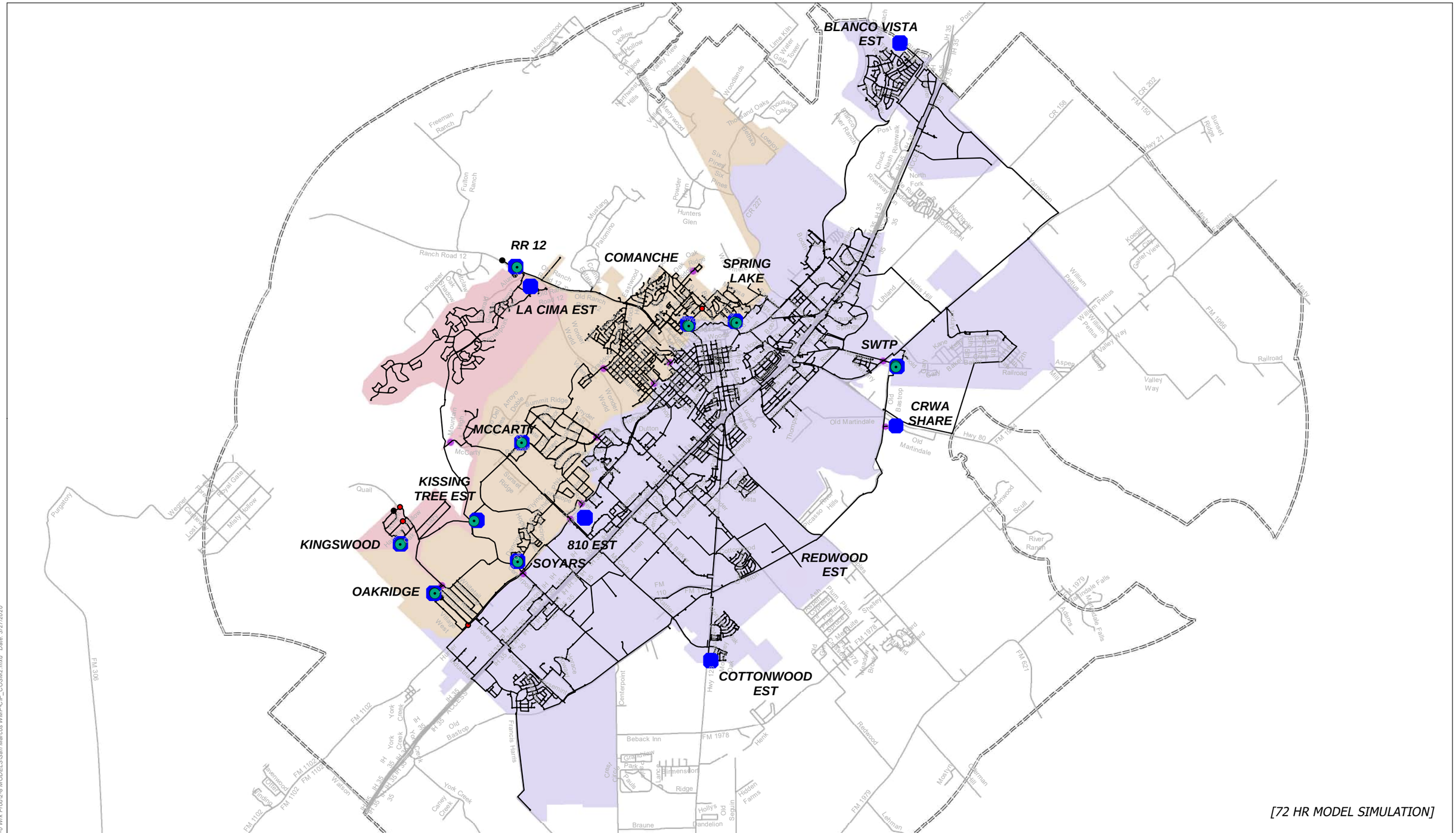
APPENDIX D

2035 SYSTEM MODEL RESULTS



[72 HR MODEL SIMULATION]

CITY OF SAN MARCOS
WATER MASTER PLAN UPDATE

EXHIBIT D-1: 2035 AVERAGE DEMAND
EPS RESULTS: MINIMUM PRESSURE

PLUMMER

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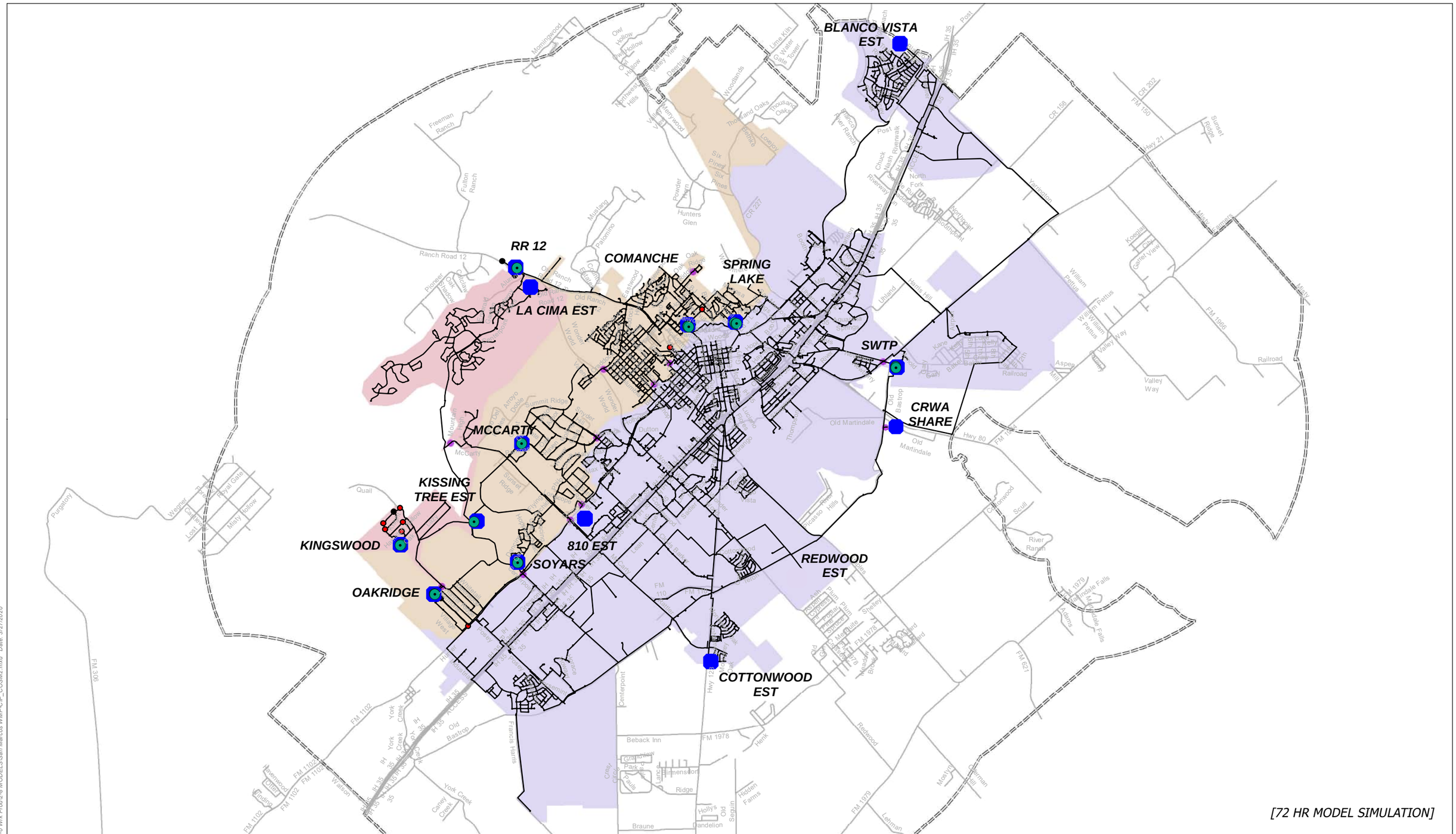

[72 HR MODEL SIMULATION]

CITY OF SAN MARCOS
WATER MASTER PLAN UPDATE

EXHIBIT D-2: 2035 MAXIMUM DEMAND
EPS RESULTS: MINIMUM PRESSURE

PLUMMER

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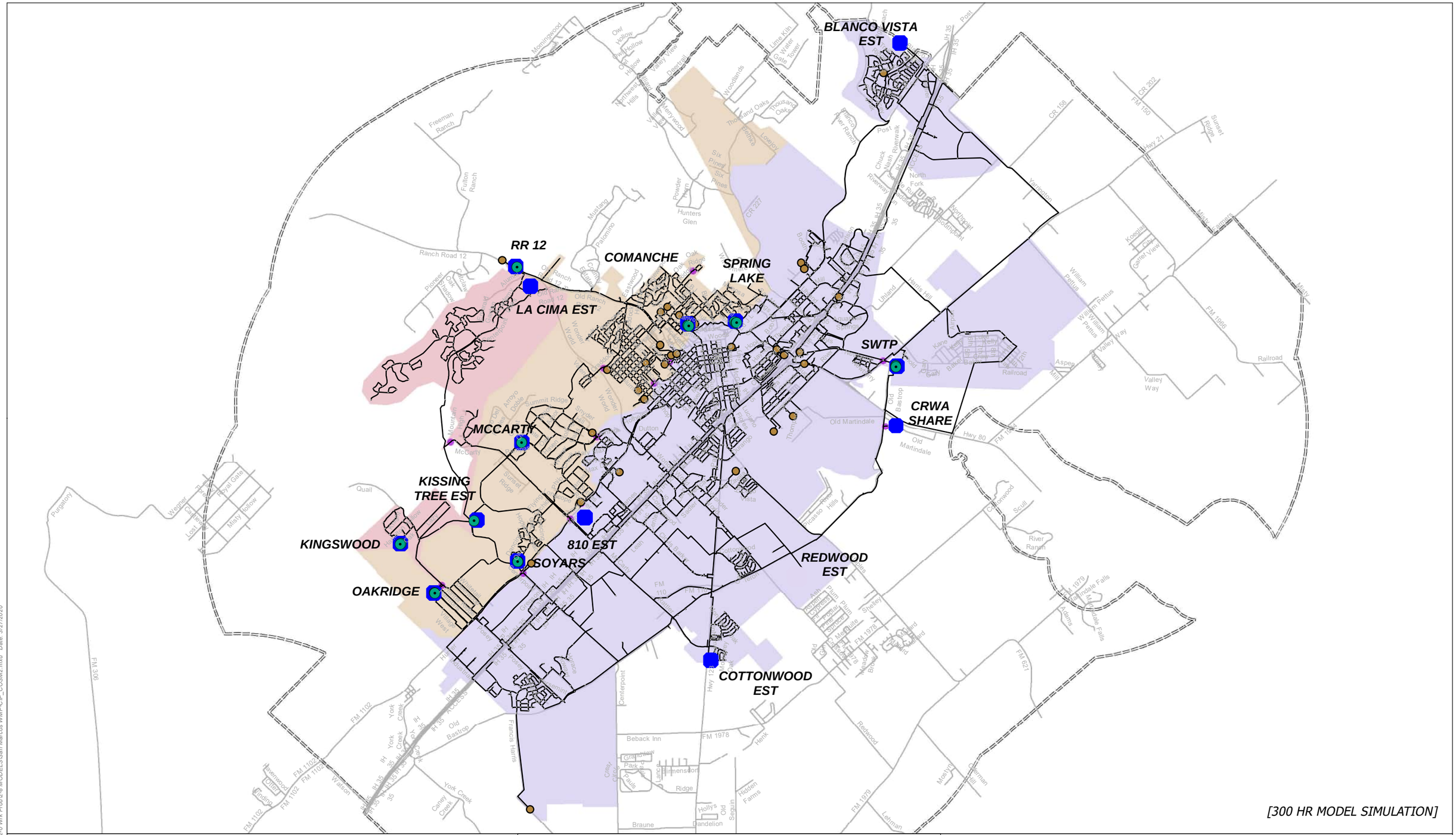

[300 HR MODEL SIMULATION]

CITY OF SAN MARCOS
WATER MASTER PLAN UPDATE

EXHIBIT D-3: 2035 AVERAGE DEMAND
EPS RESULTS: AVERAGE WATER AGE

PLUMMER

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APPENDIX E

CAPITAL IMPROVEMENTS PROGRAM PROJECTS COST OPINIONS

2020 CIP Number	Project Name	Description	Dia. (in)	Length (ft)	Tank Size	Pump Size (GPM)	Pump Qty	Year	Soil Type	$/LF	Line Placement	Pipeline Cost	Easement Width (ft)	Easement Acreage	Land Cost ($)	10% Surveying ($)	Pavement Repair Cost	Project Costs ($)	Engineering, Legal, Financing, Contingency	Environmental	Rounded Total Cost
1	Replace Comanche Pumps	New Pumps at Comanche to fill RR 12 & 50 LF 16" yard piping	16	51	-	-	-	2025	Soil	$ 104	City Property	$ 5,312	30	0.04	$ -	$ -	$ -	$ 5,312	$ 1,195	$ 122	$ 7,000
						1,250	3		-	-	-	-	-	-	-	-	-	$ 2,186,434	$ 491,948	$ -	$ 2,679,000
2	Replace Soyars Pumps	Replace Soyars pumps to fill the 936' Pressure Plane (2020) and Kissing Tree in 2025.	-	-	-	600	2	2025	-	-	-	-	-	-	-	-	-	$ 988,691	$ 222,455	$ -	$ 1,212,000
3	Hunter Rd Parallel	Hunter Road from Quail Run to Centerpoint (near Soyars) Extension in 936 Plane, serving the south side of Hunter Rd customers.	12	5,230	-	-	-	2025	Combo	$ 83	Easement / Rural & City Street	$ 433,065	30	3.60	$ 104,327	$ 10,433	-	$ 547,825	$ 123,261	$ 12,600	$ 684,000
4	Southwest 810' Plane Loop	Connect Centerpoint to Transportaiton Way in the 810' plane.	12	5,317	-	-	-	2025	Soil	$ 76	Easement/ Industrial then Rural	$ 401,568	30	3.66	$ 116,784	$ 11,678	$ -	$ 530,030	$ 119,257	$ 12,191	$ 662,000
5	Stagecoach Trail Extension	Extend line from end of Stagecoach to intersection of Belvin and Bishop (existing 12" tie in).	12	1,899	-	-	-	2025	Soil	$ 76	Easement/ Rural (Stream Crossing)	$ 143,424	30	1.65	$ 9,188	$ 919	-	$ 410,684	$ 102,671	$ 9,446	$ 523,000
		Stream crossing	12	500	-	-	-		Soil	$ 514		$ 257,153									
6	Rattler Road Loop	Complete 12" loop around the high school on Rattler Rd. and build ~500 LF of 16" to the southwest along Old Bastrop Ln.	12	2,429	-	-	-	2025	Soil	$ 76	Easement / Rural & City Street (school)	$ 183,498	30	1.67	$ 22,805	$ 2,280	$ 1,536	$ 210,119	$ 47,277	$ 4,833	$ 263,000
7	South Hunter Rd Loop	Connect existing 12" (on 810 plane) in Hunter Rd to 12" in Industrial Fork Rd.	12	3,837	-	-	-	2025	Combo	$ 83	Easement / Rural & City Street	$ 317,767	30	2.64	$ 76,551	$ 7,655	$ 3,840	$ 405,813	$ 91,308	$ 9,334	$ 507,000
8	Patricia and Sunset Acres	Upsize 2" line along Del Sol Dr and 8" line along Patricia Dr. to each be 12" diameter as a part of the Sunset Acres drainage project.	8	407	-	-	-	2025	Soil	$ 71	City Roads	$ 28,894	20	0.19	-	$ 355	$ -	$ 273,502	$ 61,538	$ 6,291	$ 342,000
			12	2,334					Soil	$ 87	City Roads	$ 203,861	30	1.61	-	$ 3,054	$ 37,338				
9	Leah Ave Extension	Install 12" to connect Leah Ave between Cottonwood Pkwy and Clovis Barker	12	6,429	-	-	-	2025	Soil	$ 83	Easement / Rural & City Street	$ 532,361	30	4.43	$ 141,210	$ 14,121	$ 1,920	$ 687,692	$ 154,731	$ 15,817	$ 859,000
10	Upgrade IH-35 Crossings	Upgrade 6 or 7 existing water line crossings to 16" Between McCarty & Aquarena Springs Rd.	12	1,389	-	-	-	2025	Combo	$ 514	Road Crossing IH-35	$ 714,389	30	0.96	-	$ 1,818	-	$ 1,480,454	$ 370,113	$ 15,817	$ 1,867,000
			16	1,482	-	-	-		Combo	$ 514		$ 762,308	30	1.02	-	$ 1,940	-				
11	Railroad Crossing and Upgrades near the Conn's shopping center.	Upgrade IH 35 crossing near the railroad crossing and upsize the 8"/10" lines to the east of IH 35.	12	1,474	-	-	-	2025	Combo	$ 96	Easement & City Street	$ 142,138	30	1.01	$ 7,378	$ 738	$ 1,536	$ 556,903	$ 125,303	$ 12,809	$ 696,000
		IH-35 Crossing Section	12	800					Combo	$ 514	Road Crossing IH-35	$ 411,444	30	0.55		$ 1,047					
12	Gas Lamp Feed	Install 12" from McCarty behind the Premium outlets to the 24" to feed new industrical development and 18" line to serve Gas Lamp.	12	3,885	-	-	-	2025	Soil	$ 64	Easement / Rural	$ 247,503	30	2.68	$ 6,614	$ 661	$ 384	$ 255,163	$ 57,412	$ 5,869	$ 319,000
13	Airport Extension	Extend 12" northeast along HWY 21	12	9,007	-	-	-	2025	Soil	$ 71	Easement	$ 639,855	30	6.20	$ 123,040	$ 12,304	-	$ 775,199	$ 174,420	$ 17,830	$ 968,000
14	Blanco Vista EST	Build 1.0 MG elevated storage tank and 24" outlet line to Blanco Vista Blvd	24	1,921		-	-	2025	Rock	$ 222	Development	$ 426,494	40	1.76	$ 39,099	$ 3,351	-	$ 468,943	$ 105,512	$ 10,786	$ 586,000
			-	-	1.0 MG	-	-		-	-	-	-	-	1.00	$ 22,167	-	-	$ 3,600,000	$ 810,000	$ 82,800	$ 4,493,000
15	Add SWTP Pump	New Pump at SWTP Pump Station	-	-	-	4,200	1	2025	-	-	-	-	-	-	-	-	-	$ 320,613	$ 72,138	$ 7,374	$ 401,000
16	12" Connection for CRWA Share	12" x 30" connection on the 30" transmission main, just south of the WTP.	12	327	-	-	-	2025	Soil	$ 64	Easement / Rural	$ 20,861	30	0.23	$ 2,719	$ 429	-	$ 24,009	$ 5,402	$ 552	$ 30,000
17 (D)	Kissing Tree Tank	New 0.50 MG Elevated Storage for 936' pressure plane	-		0.50 MG	-	-	2025	-	-	-	-	-	-	-	-	-	$ 1,800,000	$ 405,000	$ 41,400	$ 2,247,000
18 (D)	Kissing Tree PS	Pumps to fill La Cima Tank and deliver to 1063' pressure plane	12	35	-	1,400	2	2025	-	-	-	-	-	-	-	-	-	$ 2,186,434	$ 491,948	$ 50,288	$ 2,729,000
			16	1,100	-	-	-		Rock	$ 124	Easement Rural and Development	$ 136,192	30	0.76	-	$ 1,440	-	$ 137,632	$ 30,967	$ 3,166	$ 172,000
19 (D)	Kissing Tree Loop - Phase 2a	Central Loop in Development Phase I	16	1,720	-	-	-	2025	Rock	$ 146	Easement Rural and Development	$ 250,368	30	1.18	-	$ 2,250	-	$ 1,218,681	$ 274,203	$ 28,030	$ 1,521,000
20 (D)			24	4,361	-	-	-		Rock	$ 222		$ 968,313	40	4.00	-	$ 7,609	-				
21 (D)	Kissing Tree Loop - Phase 2b	Central Loop in Development Phase 2	12	19	-	-	-	2025	Rock	$ 75	Easement Rural and Development	$ 1,455	30	0.01	-	$ 26	-	$ 942,251	$ 212,007	$ 21,672	$ 1,176,000
			16	7,522	-	-	-		Rock	$ 124		$ 930,928	30	5.18	-	$ 9,843	-				
22	Kissing Tree - Kingswood Line	Connect Kissing Tree to Kingswood at Lazy Ln (include flow control valve)	12	4,706	-	-	-	2025	Combo	$ 69	Development	$ 325,497	30	3.24	-	$ 6,159	-	$ 331,655	$ 74,622	$ 7,628	$ 414,000

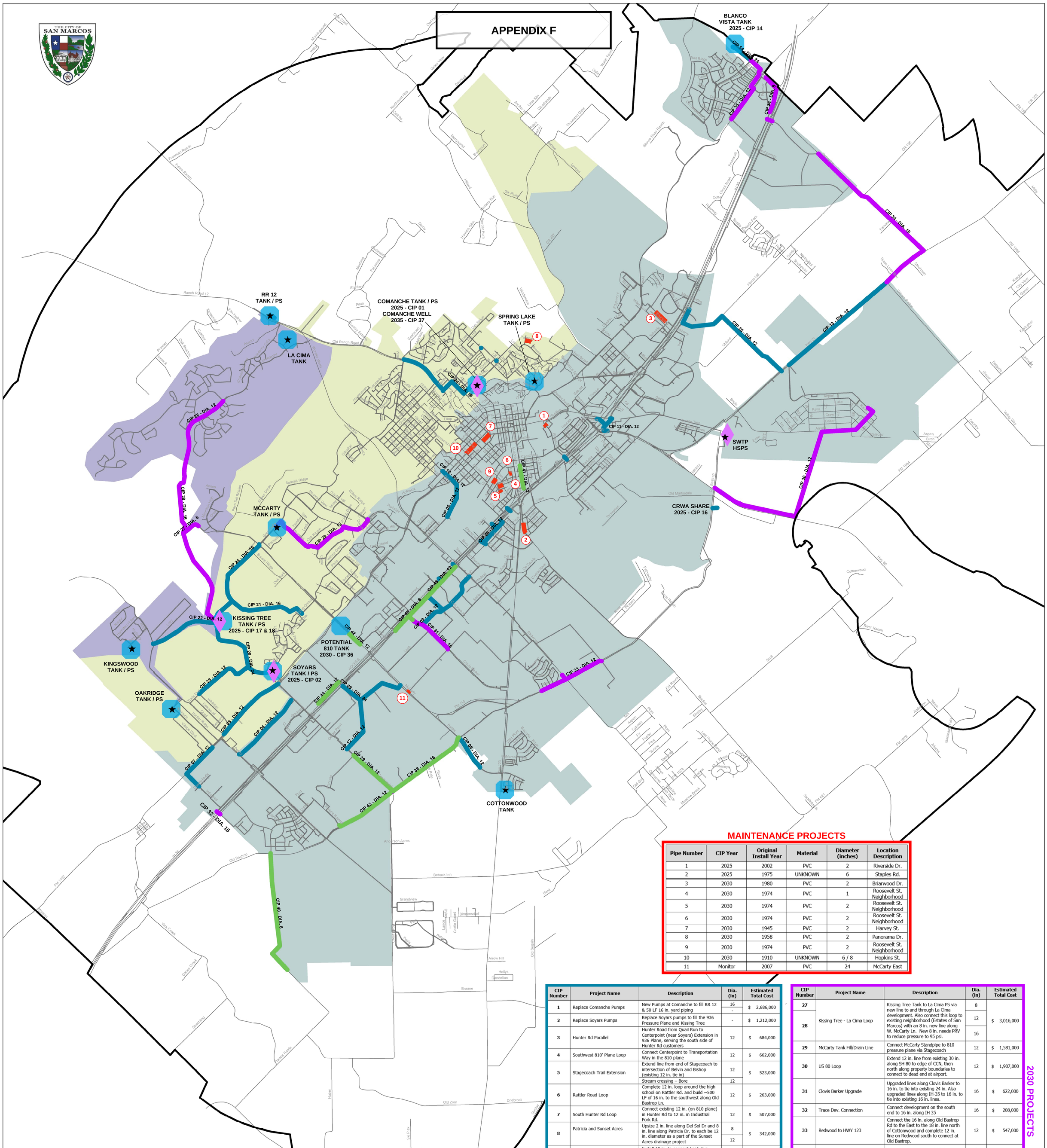
2020 CIP Number	Project Name	Description	Dia. (in)	Length (ft)	Tank Size	Pump Size (GPM)	Pump Qty	Year	Soil Type	$/LF	Line Placement	Pipeline Cost	Easement Width (ft)	Easement Acreage	Land Cost ($)	10% Surveying ($)	Pavement Repair Cost	Project Costs ($)	Engineering, Legal, Financing, Contingency	Environmental	Rounded Total Cost
23	Kissing Tree - Deerwood Line	Connect Kissing Tree Loop to Trails End	12	4,400	-	-	-	2025	Rock	$ 75	Development	$ 328,320	30	3.03	-	$ 5,758	-	$ 334,078	$ 75,167	$ 7,684	$ 417,000
24 (D)	Kissing Tree - McCarty Line	Connect Kissing Tree Loop to 16" KT line from McCarty Ln.	12	73	-	-	-	2025	Combo	$ 69	Development	$ 5,058	30	0.05	-	$ 96	-	$ 572,588	$ 128,832	$ 13,170	$ 715,000
			16	4,932					Combo	$ 114	Development	$ 560,981	30	3.40	-	$ 6,453	-				
25	Airport Loop	Connect IH 35 to HWY 21 along Harris Hill Rd, creating a loop for the northeast service area.	12	9,929	-	-	-	2025	Soil	$ 64	Easement (mainly rural)	$ 632,499	30	6.84	$ 135,642	$ 13,564	$ 768	$ 782,473	$ 176,056	$ 17,997	$ 977,000
26	Parallel Comanche Outlet Main	Parallel of existing 20"/16" Comanche PS to Craddock Ave. & RR12	16	6,981	-	-	-	2025	Rock	$ 175	Easement	$ 1,219,724	30	4.81	$ 106,576	$ 10,658	$ -	$ 1,336,958	$ 300,815	$ 30,750	$ 1,669,000
27	Kissing Tree - La Cima Loop	Kissing Tree Tank to La Cima PS via new line to and through La Cima development. Also connect this loop to existing neighborhood (Estates of San Marcos) with an 8" new line along W. McCarty Ln. New 8" needs PRV to reduce pressure to 95 psi.	8	1,308	-	-	-	2030	Rock	$ 74	Development	$ 96,390	20	0.60	-	$ 1,141	-	$ 97,531	$ 21,944	$ 2,243	$ 122,000
28			12	6,521	-	-	-		Rock	$ 90	Development	$ 587,487	30	4.49	-	$ 8,533	-	$ 2,318,144	$ 521,582	$ 53,317	$ 2,894,000
			16	11,439					Rock	$ 149	Development	$ 1,707,156	30	7.88	-	$ 14,969	-				
29	McCarty Tank Fill/Drain Line	Connect McCarty Standpipe to 810 plane via Stagecoach	12	8,376	-	-	-	2030	Rock	$ 106	Easement / Urban	$ 884,133	30	5.77	$ 346,105	$ 34,611	$ 1,536	$ 1,266,384	$ 284,936	$ 29,127	$ 1,581,000
30	US 80 Loop	Extend 12" line from existing 30" along SH 80 to edge of CCN, then north along property boundaries to connect to dead end at airport.	12	16,858	-	-	-	2030	Soil	$ 76	Easement (mostly rural)	$ 1,273,283	30	11.61	$ 230,292	$ 23,029	$ 768	$ 1,527,372	$ 343,659	$ 35,130	$ 1,907,000
31	Clovis Barker Upgrade	Upgraded lines along Clovis Barker to 16" to tie into existing 24". Also upgraded lines along IH-35 to 16" to tie into existing 16" lines.	16	3,297	-	-	-	2030	Soil	$ 146	Easement	$ 479,979	30	2.27	$ 16,505	$ 1,651	$ -	$ 498,135	$ 112,080	$ 11,457	$ 622,000
32	Trace Dev. Connection	Connect development on the south end to 16" along IH 35	16	314	-	-	-	2030	Rock	$ 514	Bore below IH-35	$ 161,648	30	0.22	$ 1,574	$ 157	$ -	$ 163,379	$ 40,845	$ 3,758	$ 208,000
33	Redwood to HWY 123	Connect the 16" along Old Bastrop Rd to the East to the 18" line north of Cottonwood and complete 12" line on Redwood south to connect at Old Bastrop.	12	5,099	-	-	-	2030	Soil	$ 76	Easement / Rural & Urban	$ 385,109	30	3.51	$ 47,861	$ 4,786	$ 384	$ 438,139	$ 98,581	$ 10,077	$ 547,000
34	North Side Connection	Add 12" line to move ARWA water from the Blanco Vista Tank to the east side of IH 35 (follow Yarrington extension).	8	1,446	-	-	-	2030	Combo	$ 78	Easement Urban (some rural)	$ 113,162	20	0.66	$ 4,827	$ 483		$ 3,106,207	$ 698,897	$ 71,443	$ 3,877,000
			12	243	-	-	-			$ 96		$ 23,421	30	0.17	$ 1,216	$ 122	$ 768				
			16	17,881	-	-	-			$ 160		$ 2,863,732	30	12.31	$ 89,525	$ 8,953					
35	Post Rd Connection	Close loop along north end of Post Rd., south of Champions Blvd	12	2,651	-	-	-	2030	Soil	$ 96	Easement	$ 255,680	30	1.83	$ 24,881	$ 2,488	$ -	$ 283,048	$ 63,686	$ 6,510	$ 354,000
36	Potential 810 Elevated Storage Tank	New elevated storage tank with overflow eelvation of 810 to be installed along McCarty Ln. near the top of the 810 pressure plane.	-	-	1.0 MG	-	-	2030	-	-	-	-	-	1.00	$ 22,167	-	-	$ 3,600,000	$ 810,000	$ 82,800	$ 4,493,000

2020 CIP Number	Project Name	Description	Dia. (in)	Length (ft)	Tank Size	Pump Size (GPM)	Pump Qty	Year	Soil Type	$/LF	Line Placement	Pipeline Cost	Easement Width (ft)	Easement Acreage	Land Cost ($)	10% Surveying ($)	Pavement Repair Cost	Project Costs ($)	Engineering, Legal, Financing, Contingency	Environmental	Rounded Total Cost
37	Add Well Capacity	Add groundwater well at Comanche.	-		-	1,100	1	2035	-	-	-	-	-	-	-	-	-	$ 988,691	$ 222,455	$ 22,740	$ 1,234,000
38	Old Bastrop Extension 2	Rattler to Centerpoint Extension along Old Bastrop Highway	16	6,012	-	-	-	2035	Soil	$ 146	Easement	$ 875,323	30	4.14	$ 153,342	$ 15,334	$ -	$ 1,044,000	$ 234,900	$ 24,012	$ 1,303,000
39	Centerpoint Extension	Install 16" perpendicular to Old Bastrop to 12" Existing Line	12	2,014	-	-	-	2035	Soil	$ 87	Easement	$ 175,960	30	1.39	$ 18,840	$ 1,884	$ -	$ 452,197	$ 101,744	$ 10,401	$ 565,000
			16	1,706					Soil	$ 146	Easement	$ 248,328	30	1.17	$ 6,533	$ 653	$ -				
40	Francis Harris Extension	Extend 8" line from existing terminus of 12" line in Old Bastrop to Francis Harris, then along Francis Harris to power plant.	8	8,824	-	-	-	2035	Soil	$ 51	City Roads	$ 449,691	20	4.05	$ -	$ 7,698	$ 141,192	$ 598,581	$ 134,681	$ 13,767	$ 748,000
41	South LBJ Upgrade	Upgrade small diameter line in S. LBJ from E. Grove St. to IH-35 Crossing	12	1,630	-	-	-	2035	Rock	$ 106	City Roads	$ 172,032	30	1.12	$ -	$ 2,133	$ 26,076	$ 200,240	$ 45,054	$ 4,606	$ 250,000
42	McCarty Connection	Extend existing 12" line further south along E. McCarty Lane toward IH-35 to connect to future growth area.	12	1,186	-	-	-	2035	Rock	$ 106	City Roads	$ 125,203	30	0.82	$ -	$ 1,552	$ 18,978	$ 145,733	$ 32,790	$ 3,352	$ 182,000
43	Old Bastrop Extension 3	Centerpoint to Horace Howard Extension along Old Bastrop Highway, Include connection to existing line on Horace Howard Dr.	12	4,195	-	-	-	2035	Soil	$ 87	Easement	$ 366,450	30	2.89	$ 39,375	$ 3,937	$ -	$ 370,388	$ 83,337	$ 8,519	$ 463,000
44	Tanger Loop	Connect existing 24" to end of proposed 12" developer line along IH-35 north of Centerpoint (Behind Bill Miller's)	12	2,058	-	-	-	2035	Soil	$ 87	Easement	$ 179,763	30	1.42	$ 141,718	$ 14,172	$ -	$ 335,653	$ 75,522	$ 7,720	$ 419,000
45	IH 35 Frontage Upgrades	Upgrade IH 35 lines along northbound side to 16" pipes from tan warehouse building north of McCarty to the northeast until Wonder World Dr.	16	6,542	-	-	-	2035	Soil	$ 146	Easement	$ 952,471	30	4.51	$ 143,692	$ 14,369	$ 1,536	$ 1,112,068	$ 250,215	$ 25,578	$ 1,388,000

APPENDIX F

CAPITAL IMPROVEMENTS PROGRAM PROJECTS LARGE FORMAT MAP

APPENDIX F



MAINTENANCE PROJECTS

Pipe Number	CIP Year	Original Install Year	Material	Diameter (inches)	Location Description
1	2025	2002	PVC	2	Riverside Dr.
2	2025	1975	UNKNOWN	6	Staples Rd.
3	2030	1980	PVC	2	Briarwood Dr.
4	2030	1974	PVC	1	Roosevelt St. Neighborhood
5	2030	1974	PVC	2	Roosevelt St. Neighborhood
6	2030	1974	PVC	2	Roosevelt St. Neighborhood
7	2030	1945	PVC	2	Harvey St.
8	2030	1958	PVC	2	Panorama Dr.
9	2030	1974	PVC	2	Roosevelt St. Neighborhood
10	2030	1910	UNKNOWN	6 / 8	Hopkins St.
11	Monitor	2007	PVC	24	McCarty East

2025 PROJECTS

CIP Number	Project Name	Description	Dia. (in)	Estimated Total Cost
1	Replace Comanche Pumps	New Pumps at Comanche to fill RR 12 & 50 LF 16 in. yard piping	16 -	$ 2,686,000
2	Replace Soyars Pumps	Replace Soyars pumps to fill the 936 Pressure Plane and Kissing Tree	-	$ 1,212,000
3	Hunter Rd Parallel	Hunter Road from Quail Run to Centerpoint (near Soyars) Extension in 936 Plane, serving the south side of Hunter Rd customers	12	$ 684,000
4	Southwest 810' Plane Loop	Connect Centerpoint to Transportation Way in the 810 plane	12	$ 662,000
5	Stagecoach Trail Extension	Extend line from end of Stagecoach to intersection of Belvin and Bishop (existing 12 in. tie in)	12	$ 523,000
		Stream crossing – Bore	12	
6	Rattler Road Loop	Complete 12 in. loop around the high school on Rattler Rd. and build ~500 LF of 16 in. to the southwest along Old Bastrop Ln.	12	$ 263,000
7	South Hunter Rd Loop	Connect existing 12 in. (on 810 plane) in Hunter Rd to 12 in. in Industrial Fork Rd.	12	$ 507,000
8	Patricia and Sunset Acres	Upsize 2 in. line along Del Sol Dr and 8 in. line along Patricia Dr. to each be 12 in. diameter as a part of the Sunset Acres drainage project	8 12	$ 342,000
9	Leah Ave Extension	Install 12 in. to connect Leah Ave between Cottonwood Pkwy and Clovis Barker	12	$ 859,000
10	Upgrade IH-35 Crossings	Upgrade 6 or 7 existing water line crossings to 16 in. Between McCarty & Aquarena Springs Rd.	12 16	$ 1,867,000
11	Railroad Crossing and Upgrades near the Conn's shopping center	Upgrade IH 35 crossing near the railroad crossing and upsize the 8 in./10 in. lines to the east of IH 35	12	$ 696,000
		IH-35 Crossing Section	12	
12	Gaslamp Feed	Install 12 in. from McCarty behind the Premium outlets to the 24 in. to feed Gaslamp / Gaslamp and 18 in. line to serve Gaslamp	12	$ 319,000
13	Airport Extension	Extend 12 in. northeast along HWY 21	12	$ 968,000
14	Blanco Vista EST	Build 1.0 MG elevated storage tank and 24 in. outlet line to Blanco Vista Blvd	24 -	$ 586,000 $ 4,493,000
15	Add SWTP Pump	New Pump at SWTP Pump Station	-	$ 401,000
16	12 in. Connection for CRWA Share	12 in. x 30 in. connection on the 30 in. transmission main, just south of the WTP	12	$ 30,000
17 (D)	Kissing Tree Tank	New 0.50 MG Elevated Storage for 936 pressure plane	-	$ 2,247,000
18 (D)	Kissing Tree PS	Pumps to fill La Cima Tank and deliver to 1063 pressure plane	12 16	$ 2,729,000 $ 172,000
19 (D) 20 (D)	Kissing Tree Loop - Phase 2a	Central Loop in Development Phase I	16 24	$ 1,521,000
21 (D)	Kissing Tree Loop - Phase 2b	Central Loop in Development Phase 2	12 16	$ 1,176,000
22	Kissing Tree - Kingswood Line	Connect Kissing Tree to Kingswood at Lazy Ln (include flow control valve)	12	$ 414,000
23	Kissing Tree - Deerwood Line	Connect Kissing Tree Loop to Trails End	12	$ 417,000
24 (D)	Kissing Tree - McCarty Line	Connect Kissing Tree Loop to 16 in. KT line from McCarty Ln.	12 16	$ 715,000
25	Airport Loop	Connect IH-35 to HWY 21 along Harris Hill Rd, creating a loop for the northeast service area	12	$ 977,000
26	Parallel Comanche Outlet Main	Parallel of existing 20 in./16 in. Comanche PS to Craddock Ave. & RR12	16	$ 1,669,000

2030 PROJECTS

CIP Number	Project Name	Description	Dia. (in)	Estimated Total Cost
27	Kissing Tree - La Cima Loop	Kissing Tree Tank to La Cima PS via new line to and through La Cima development. Also connect this loop to existing neighborhood (Estates of San Marcos) with an 8 in. new line along W. McCarty Ln. New 8 in. needs PRV to reduce pressure to 95 psi.	8 12 16	$ 3,016,000
28				
29	McCarty Tank Fill/Drain Line	Connect McCarty Standpipe to 810 pressure plane via Stagecoach	12	$ 1,581,000
30	US 80 Loop	Extend 12 in. line from existing 30 in. along SH 80 to edge of CCN, then north along property boundaries to connect to dead end at airport.	12	$ 1,907,000
31	Clovis Barker Upgrade	Upgraded lines along Clovis Barker to 16 in. to tie into existing 24 in. Also upgraded lines along IH-35 to 16 in. to tie into existing 16 in. lines.	16	$ 622,000
32	Trace Dev. Connection	Connect development on the south end to 16 in. along IH 35	16	$ 208,000
33	Redwood to HWY 123	Connect the 16 in. along Old Bastrop Rd to the East to the 18 in. line north of Cottonwood and complete 12 in. line on Redwood south to connect at Old Bastrop.	12	$ 547,000
34	North Side Connection	Add 12 in. line to move ARWA water from the Blanco Vista Tank to the east side of IH 35 (follow Yarrington extension).	8 12 16	$ 3,877,000
35	Post Rd Connection	Close loop along north end of Post Rd., south of Champions Blvd	12	$ 354,000
36	Potential 810 Elevated Storage Tank	New elevated storage tank with overflow elevation of 810 to be installed along McCarty Ln. near the top of the 810 pressure plane.	-	$ 4,493,000

2035 PROJECTS

CIP Number	Project Name	Description	Dia. (in)	Estimated Total Cost
37	Add Well Capacity	Add groundwater well at Comanche.	-	$ 1,234,000
38	Old Bastrop Extension 2	Rattler to Centerpoint Extension along Old Bastrop Highway	16	$ 1,303,000
39	Centerpoint Extension	Install 16 in. perpendicular to Old Bastrop to 12 in. Existing Line	12 16	$ 565,000
40	Francis Harris Extension	Extend 8 in. line from existing terminus of 12 in. line in Old Bastrop to Francis Harris, then along Francis Harris to power plant.	8	$ 748,000
41	South LBJ Upgrade	Upgrade small diameter line in S. LBJ from E. Grove St. to IH-35 Crossing	12	$ 250,000
42	McCarty Connection	Extend existing 12 in. line further south along E. McCarty Lane toward IH-35 to connect to future growth area.	12	$ 182,000
43	Old Bastrop Extension 3	Centerpoint to Horace Howard Extension along Old Bastrop Highway, Include connection to existing line on Horace Howard Dr.	12	$ 463,000
44	Tanger Loop	Connect existing 24 in. to end of proposed 12 in. developer line along IH-35 north of Centerpoint (Behind Bill Miller's)	12	$ 419,000
45	IH 35 Frontage Upgrades	Upgrade IH 35 lines along northbound side to 16 in. pipes from tan warehouse building north of McCarty to the northeast until Wonder World Dr.	16	$ 1,388,000

PLUMMER

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City of San Marcos: Water Master Plan Update
Capital Improvement Projects: 2025, 2030, and 2035
08/03/2020

APPENDIX G

CANYON REGIONAL WATER AUTHORITY – CITY OF SAN MARCOS SHARED FACILITIES STUDY

DRAFT

Hays Caldwell Water Treatment Plant

Shared Facilities Study

Canyon Regional Water Authority
and
City of San Marcos

This draft report is released for review under the authority of Alan V. Thompson, PE, Texas # 38455.

Prepared By:

LNV, Inc.
8918 Tesoro Drive, Suite 401
San Antonio, Texas 78217
210-822-2232
TBPE Firm No. 366

May 1, 2019

engineers | architects | surveyors

TBPE FIRM NO. F-366

SECTION	TITLE	PAGE

Tables

Tables (continued)

Exhibits

Executive Summary

The Shared Facilities Study for the Hays Caldwell Water Treatment Plant (HCWTP) was performed to prepare conceptual planning and analyses to define opportunities for Canyon Regional Water Authority (CRWA) and the City of San Marcos (COSM) to utilize the HCWTP and associated water distribution system to treat and deliver additional water that can be shared with CRWA members and the COSM. Three areas of interest were studied:

- Source Water
- Facility Improvements
- Water Distribution System

The HCWTP currently has 2.59 million gallons of water per day (mgd) committed to the plant for treatment. The plant can operate at 3.44 mgd to assist in meeting peak demands for its participants.

The membranes at the plant are rated at 5.5 mgd but cannot be fully utilized because of a lack of water to be treated and some of the existing facilities cannot operate at that flow rate. There is capacity to treat additional water at the plant if the water is available and some facility and operational improvements are made.

The City of San Marcos has 1.17 mgd of water and Martindale Water Supply Corporation has 0.23 mgd of water that could be committed to HCWTP for treatment and use. This would bring the total water committed to the plant to 3.99 mgd. This water could be used during peak periods with a peaking factor of 1.35.

If the City of San Marcos and Martindale elect to commit the water to the HCWTP, the entities would be required to pay “buy-in” cost to use the investment made by others. If both entities commit the water to the plant, the buy-in cost for San Marcos would be $3,406,659 and for Martindale WSC, the cost would be $359,618 (for additional water only). If only San Marcos commits the water, the cost to San Marcos would be $3,613,574.

An analysis was made of existing plant facilities and operations, and from that analysis, the following improvements were identified. These improvements will facilitate protection of the plant from flooding, better utilization of the plant treatment capacity and reduce operation and maintenance cost.

1. Construct flood wall (increase plant reliability and protect investment)

2. Construct a new decant and water recycle system (improve operational efficiency and reduce cost)
3. Replace existing hydraulically-deficient piping and pumps (reduce operation cost and increase reliability)
4. Construct a new raw water clarifier (improve plant efficiency and provide operational redundancy)
5. Construct new finished water storage tank (improve plant efficiency and provide operational redundancy)
6. Acquire adjacent tract (improve operational efficiency, secure plant site and have additional area to assist in meeting San Marcos Development Code requirements)
7. Construct new water transmission pipeline to serve County Line SUD, Martindale WSC and Maxwell WSC (operational efficiency and increase system reliability)
8. Construct new water transmission pipeline to serve San Marcos (operational efficiency and increase system reliability)

An estimate of probable construction cost was prepared for each item (with a 30 percent contingency). The items in the list are not sequential. The items can be implemented as needed by the project participants.

A summary of the project estimated opinion of probable construction cost is as follows:

1. Flood Wall - $1,993,400

2. New Decant and Recycling System - $1,925,300

3. Replace Hydraulically Deficient Piping - $1,628,300

4. New Raw Water Clarifier - $2,508,200

5. New Finished Water Storage Tank - $1,954,700

6. Acquire Adjacent Tract - $375,000

   SUBTOTAL OF ITEMS 1 THROUGH 6 - $10,384,900

7. New County Line and Maxwell Pipeline - $12,811,300

8. New San Marcos Pipeline - $3,525,000

   SUBTOTAL OF ITEMS 1 THROUGH 8 - $26,712,200

The following sequence is recommended to move forward with implementation of the shared facilities:

1. CRWA will request endorsement of the shared facilities project with members of HCWTP that participate in the project.

2. The CRWA will be requested to endorse the shared facilities project.

3. The City of San Marcos and Martindale WSC will be requested to commit the identified water supplies to the HCWTP.

4. The parties with interest in the HCWTP will then select the improvements they are wanting to move forward considering recommendations from CRWA staff.

5. An engineering feasibility study will be completed for the selected projects.

6. The results of the engineering feasibility study will be used to select the preferred financing method to implement the projects.

7. Funds will be obtained to implement the projects.

8. Complete planning, permitting, design and construction.

The proposed shared facilities will further endorse the concept of a regional water supply, bring additional source water to the HCWTP and improve operation of the plant and facilitate delivery of treated water to the project participants.

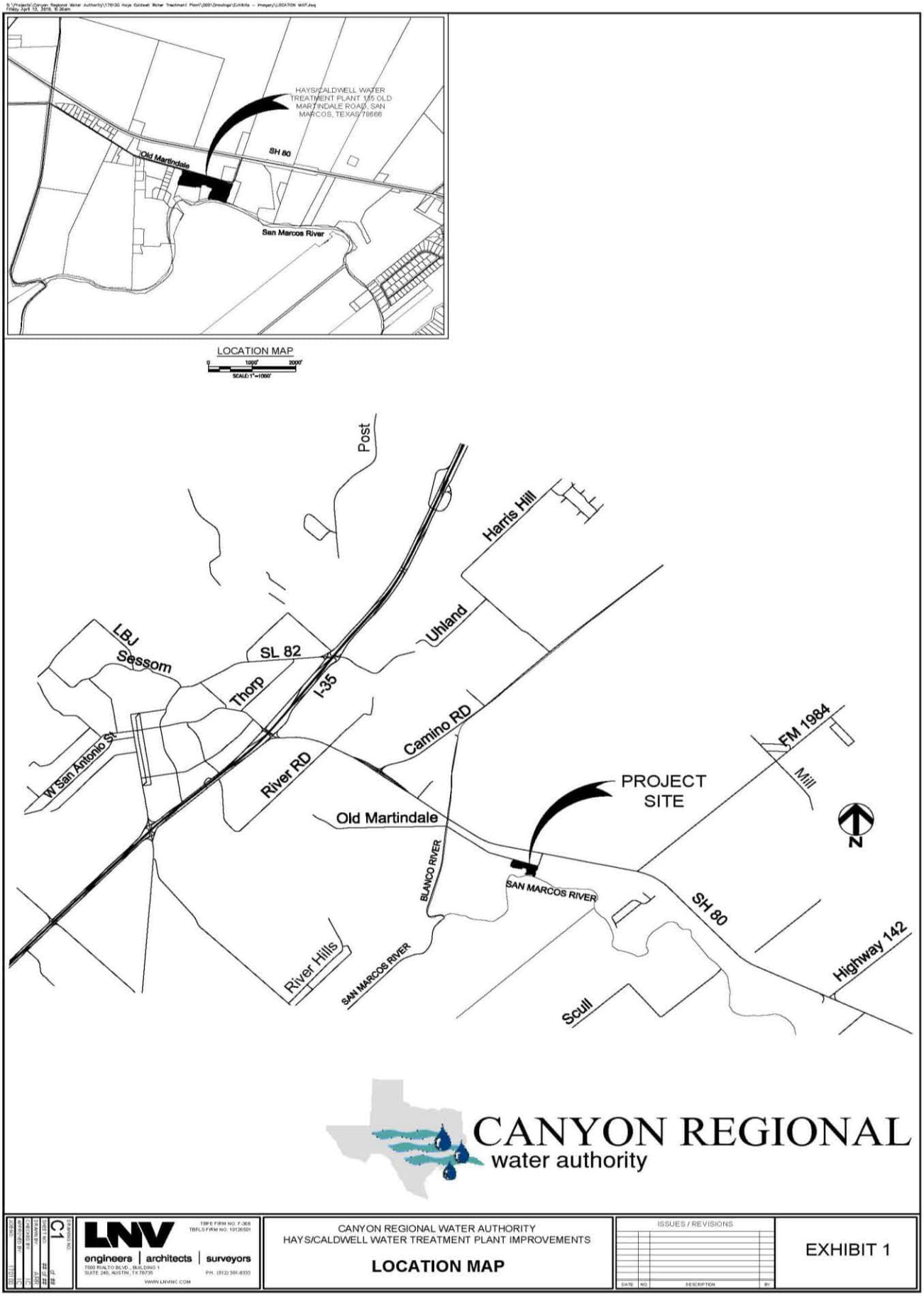
Section 1
Introduction and Purpose

The Shared Facilities Study for the Hays Caldwell Water Treatment Plant (HCWTP) was performed to prepare conceptual planning and analyses to define opportunities for Canyon Regional Water Authority (CRWA) and the City of San Marcos (COSM) to utilize the HCWTP and associated water distribution system to treat and deliver additional water that can be shared with CRWA members and the COSM. Three areas of interest were studied:

- Source Water
- Facility Improvements
- Water Distribution System

The HCWTP is located at 135 Old Martindale Road, San Marcos, Texas 78666, on the northern bank of the San Marcos River as shown in **Exhibit 1**Error! Reference source not found.**.** The HCWTP is currently rated at 5.5 million gallons per day (mgd) at 35 degrees Fahrenheit. The plant production rate is currently limited to a daily average of 2.59 mgd based the raw water supply available to the plant and capacity limitations of the existing San Marcos River diversion take-out pump.

CRWA is currently carrying out a plant improvement project (2017 Texas Water Development Board Bond Project) that will enable HCWTP to switch to a free-chlorine disinfection protocol, add a finish water storage tank and construct a new river water intake. The improvements proposed as part of the 2017 TWDB Bond Project will be designed for an interim capacity of 6.0 mgd and where practical, be configured to accommodate a future expansion of the facility to an ultimate treatment capacity of 12 mgd. Components of the HCWTP influenced by the 2017 TWDB Bond Project will address the interim and ultimate treatment capacities but will not change the rated capacity of HCWTP. The clarifiers, flocculation/coagulation, ultrafiltration (UF) membranes, high service pumps, and existing chemical feed, except the final chlorination point, are not included in 2017 TWDB Bond Project.


HAYS/CALDWELL WATER TREATMENT PLANT 105 OLD MARTINDALE ROAD, SAN MARCOS, TEXAS 78666
Old Martindale
SH 80
San Marcos River
LOCATION MAP
SCALE: 1" = 1000'
Post
Harris Hill
LBJ
Sessom
SL 82
Thorp
I-35
Uhland
Camino RD
W San Antonio St
River RD
Old Martindale
PROJECT SITE
FM 1984
Mill
N
BLANCO RIVER
SAN MARCOS RIVER
SH 80
Highway 142
River Hills
SAN MARCOS RIVER
Scull
CANYON REGIONAL
water authority
LNV
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CANYON REGIONAL WATER AUTHORITY
HAYS/CALDWELL WATER TREATMENT PLANT IMPROVEMENTS
LOCATION MAP
ISSUES / REVISIONS
DATE
NO.
DESCRIPTION
BY
EXHIBIT 1

Section 2
Project Background

The HCWTP is in the heart of one of the fastest growing parts of Texas. CRWA members County Line Special Utility District (SUD), Crystal Clear SUD, Martindale Water Supply Corporation WSC) and Maxwell WSC currently take treated water from the HCWTP. The City of San Marcos is located adjacent to Crystal Clear and Maxwell and has water rights in the San Marcos River that could be diverted and treated at the HCWTP. **Exhibit 2** shows the boundaries of the Certificates of Convenience and Necessity (CCN) held by each entity.

The proximity of all five entities, the location of the HCWTP and its distribution system combined with the availability of other surface water in the river not currently committed to the HCWTP provide the opportunity for the entities to share the benefits and cost of new expanded water supplies and treatment facilities to meet future needs and reduce the cost of water for all entities.

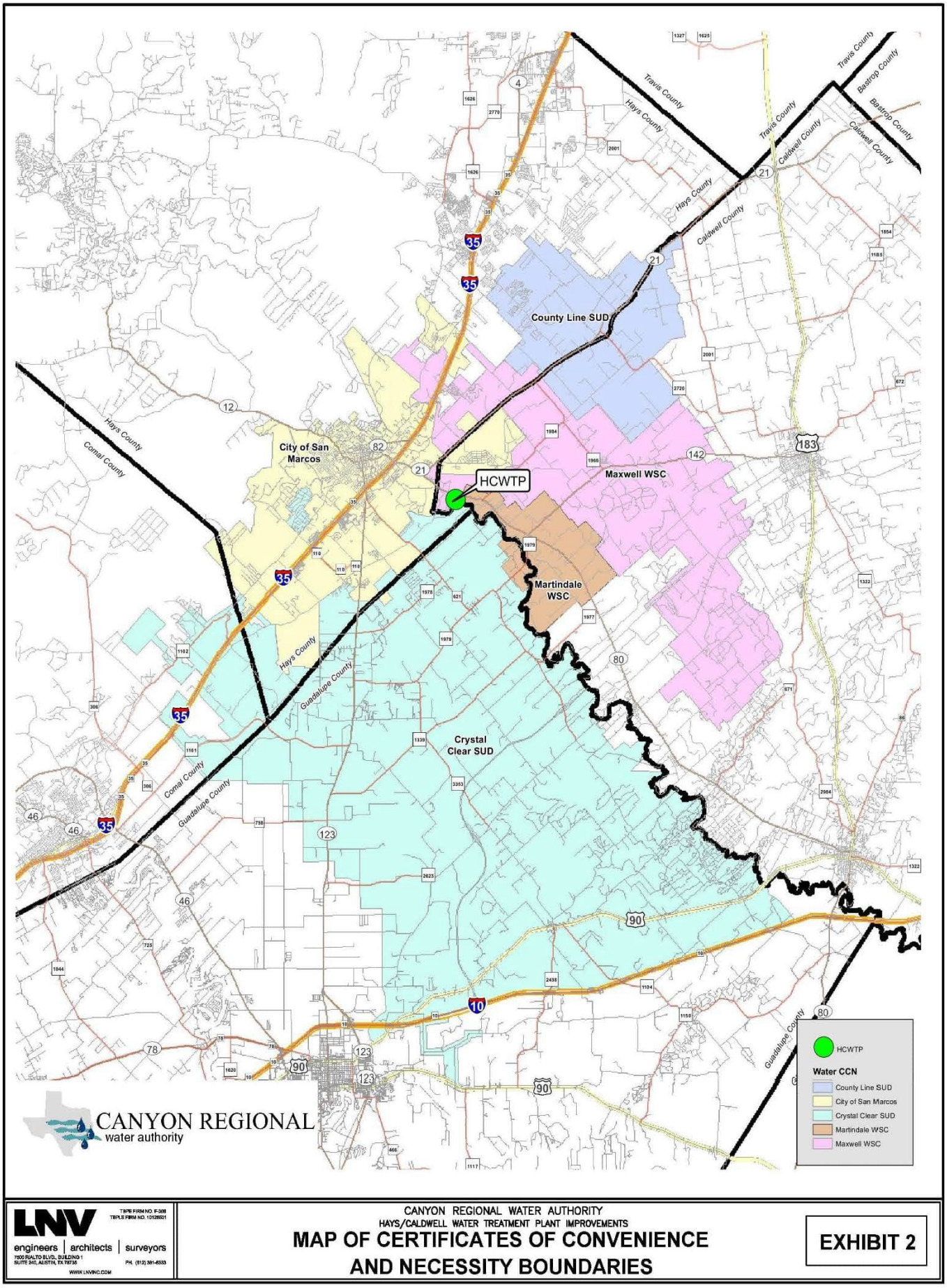
Section 3
Source Water

The HCWTP treats surface water it receives from an existing San Marcos River intake and from the Guadalupe River through a pipeline operated by the Guadalupe-Blanco River Authority (GBRA).

Table 1 presents a summary of the existing source water for the HCWTP. The average daily flow is 2.59 mgd but as needed, the plant can be operated at 3.44 mgd based on the combined capacity of the GBRA delivery from the Guadalupe River and pumping from the San Marcos River so long as the average annual pumping rate does not exceed 2.59 mgd. The production rate of 3.44 mgd represents a 1.33 peaking factor over the average daily flow of 2.59 mgd. The peaking factor assists in meeting increased water demands during summer months so that as much of the annually appropriated capacity can be used because of the lower water demands in the winter months.

The division of the average 2.59 mgd among the plant participants in shown in **Table 1**. While these capacities represent what the participants are responsible for funding, the entities work cooperatively to share daily production among the group to meet demands of each member from unused capacity of other participants. A true-up of water use at the end of each year allows the entities to work with each other to recover cost as needed.

Additional river water that could be treated in at the HCWTP has been identified and is also presented in **Table 1**. The total is 1,569.84 Acre-Feet per year or 1.40 mgd. The additional water



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CANYON REGIONAL WATER AUTHORITY
HAYS/CALDWELL WATER TREATMENT PLANT IMPROVEMENTS

MAP OF CERTIFICATES OF CONVENIENCE AND NECESSITY BOUNDARIES

EXHIBIT 2

TABLE 1

SOURCE WATER FOR HAYS CALDWELL WATER TREATMENT PLANT

April 12, 2019

EXISTING SOURCES	TOTAL ANNUAL AMOUNT, acre-feet/year	AVERAGE DAILY VOLUME mgd	COUNTY LINE VOLUME acre-feet/year	CRYSTAL CLEAR VOLUME acre-feet/year	MARTINDALE VOLUME acre-feet/year	MAXWELL VOLUME acre-feet/year	SAN MARCOS VOLUME acre-feet/year
Guadalupe-Blanco River Authority	2,038.00	1.82	1,052.00	292.00	50.00	644.00	-
Baugh B&B Family Partnership	320.00	0.29	60.00	106.56	140.16	13.28	-
Cummings Water Rights	516.16	0.46	188.00	93.44	-	234.72	-
Foster Water Rights	24.00	0.02	8.00	8.00	-	8.00	-
TOTAL EXISTING	2,898.16	2.59	1,308.00	500.00	190.16	900.00	-
POSSIBLE ADDITIONAL SOURCES	**TOTAL AMOUNT, acre-feet/year**	**AVERAGE DAILY VOLUME mgd**	**COUNTY LINE VOLUME acre-feet/year**	**CRYSTAL CLEAR VOLUME acre-feet/year**	**MARTINDALE VOLUME acre-feet/year**	**MAXWELL VOLUME acre-feet/year**	**SAN MARCOS VOLUME acre-feet/year**
San Marcos (TSU Reuse Trade)	1,164.00	1.04	-	-	-	-	1,164.00
Martindale WSC	255.84	0.23	-	-	255.84	-	-
Wooten Water Right (San Marcos)[1]	150.00	0.13	-	-	-	-	150.00
TOTAL ADDITIONAL	1,569.84	1.40	-	-	255.84	-	1,314.00
TOTAL EXISTING AND ADDITIONAL	**4,468.00**	**3.99**	**1,308.00**	**500.00**	**446.00**	**900.00**	**1,314.00**
ADDITIONAL WATER NEEDED TO 6 MGD	**2,253.32**	**2.01**					
ADDITIONAL WATER NEEDED TO 12 MGD	**8,974.64**	**8.01**					

Note:

[1] Water right is downstream and requires a permit amendment to move to HCWTP intake; is not a firm water right

from San Marcos and Martindale WSC is considered as reliable sources while the Wooten water right has a permit date that impacts its reliability. In addition, the Wooten right would have to be moved upstream to the CRWA river intake and the size of the right may be impacted based on water availability modeling and obtaining an amendment to the water right from the Texas Commission on Environmental Quality (TCEQ). The division of the possible additional sources is shown in **Table 1.**

The sum of the source water from existing sources and possible additional sources is 4,468.00 acre-feet per year or 3.99 mgd. If improvements are made to the plant to treat up to the rated 5.5 mgd capacity of the membranes, a peaking factor of 1.38 could be obtained. In addition, if the remaining parts of the plant are upgraded to treat 5.5 mgd, a portion of the buffer in the peaking capacity could be used to treat other surface water that may become available for the plant.

The HCWTP was originally laid out to enable expansion of the treatment building to increase the plant capacity to 12.0 mgd. CRWA will need to obtain an additional 8.01 mgd (8,974.64 acre-feet per year) beyond the 3.99 mgd to run the plant at a constant production rate of 12.0 mgd.

The cost of the source water for the 2.59 mgd capacity is included in the operating and funding agreements for the HCWTP. If City of San Marcos and Martindale WSC elect to have the additional 1.40 mgd treated at the HCWTP, it is anticipated that there will be no cost incurred by CRWA to dedicate the water to the plant.

The City of San Marcos and Martindale could enter agreements with the other plant participants to take portions of the additional water treated at the plant if San Marcos and Martindale WSC are not in need of the treated water at this time.

SECTION 4
Facility Improvements

HCWTP is currently rated at 3.44 mgd and CRWA has underway an improvement program (2017 Texas Water Development Board Bond Project) to add necessary disinfection and unit process improvements to enable HCWTP to switch to a free-chlorine disinfection protocol, add a finished water storage tank and construct a new water intake facility.

Exhibit 3 shows the existing plant followed by **Exhibit 4** that illustrates the boundary of the 100-year floodplain and 100-year floodway as shown by the current effective Federal Emergency Management Agency (FEMA) maps. The improvements proposed as part of this project will be designed for an interim capacity of 5.5 mgd and to accommodate the future expansion of the facility to an ultimate treatment capacity of 12 mgd. All components of the HCWTP influenced

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EXISTING HAYS CALDWELL WATER TREATMENT PLANT

EXHIBIT 3

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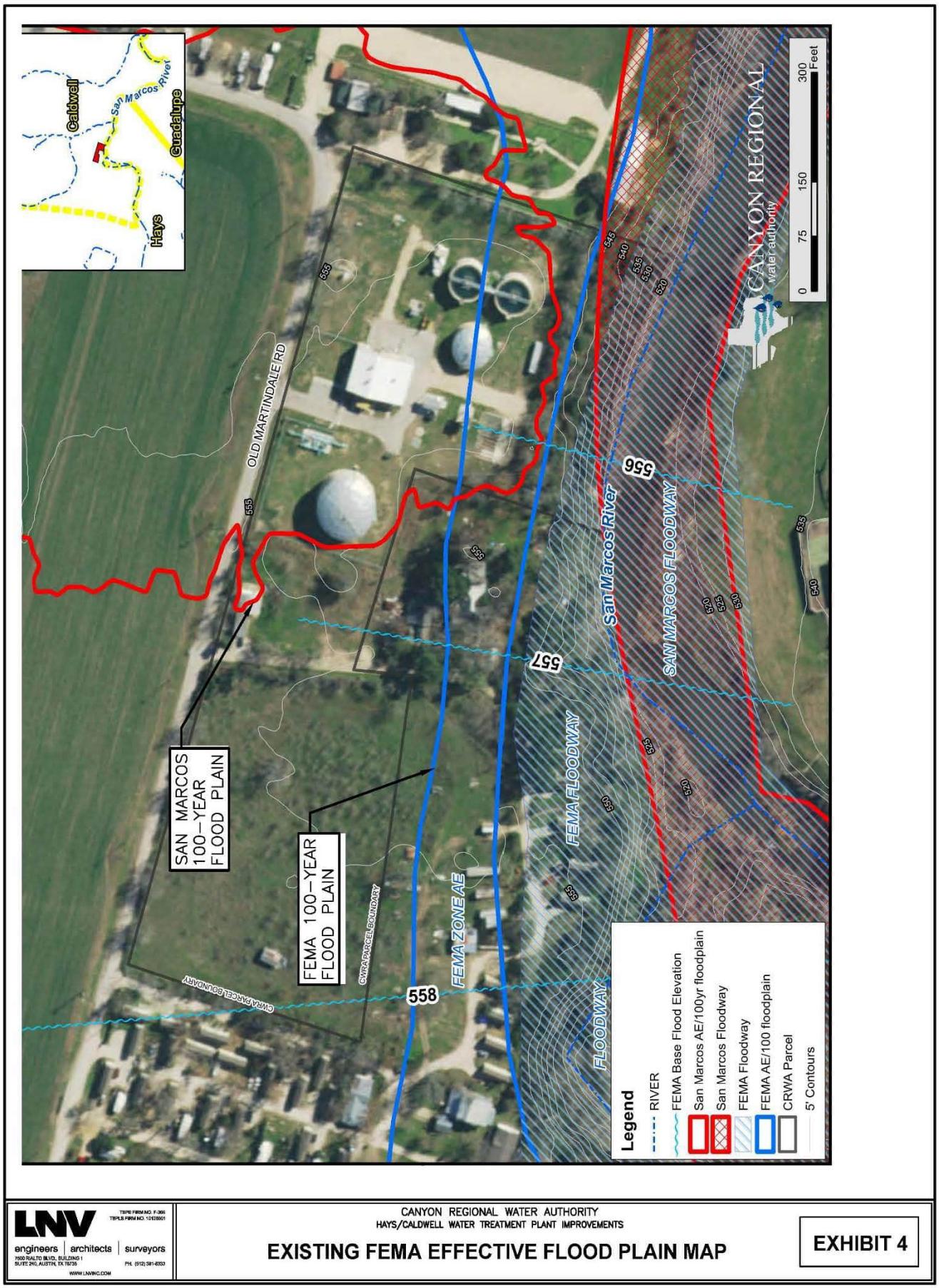

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EXISTING FEMA EFFECTIVE FLOOD PLAIN MAP

EXHIBIT 4

by the improvements proposed as part of the 2017 project will be addressed with consideration for both the interim and ultimate treatment capacities but the 2017 project will not change the current rated capacity of HCWTP. The proposed 2017 TWDB Bond Projects are illustrated on **Exhibit 5**. As part of the Preliminary Engineering Report prepared for 2017, a hydraulic analysis was completed for the HCWTP. **Table 2** illustrates the results of the hydraulic evaluation.

TABLE 2

HYDRAULIC EVALUATION OF EXISTING PLANT

		6 MGD Interim Flow		12 MGD Ultimate Flow	
Item No.	**Component**	**Status**	**Min. Improvement Needed**	**Status**	**Min. Improvement Needed**
1	**Raw Water Pump**	Inadequate	New Pump Station	Inadequate	New Pump Station
2	**Raw Water Pipeline (SM River to GBRA)**	Inadequate	Upsize to 14-inch	Inadequate	Upsize to 18-inch
***3**	**Raw Water Pipeline (GBRA to Clarifier)**	OK	N/A	Inadequate	Split Flow to New Clarifiers
***4**	**Raw/Reject Water Pump Station**	OK	N/A	Inadequate	Additional Pump
***5**	**Clarifiers**	Marginal	N/A	Inadequate	2 Additional 65' dia. Clarifiers
***6**	**Settled Water Pipeline**	OK	N/A	Marginal	N/A
***7**	**Settled Water Storage Tank**	OK	N/A	OK	N/A
***8**	**Membrane Building Influnet Line**	Marginal	N/A	Inadequate	Flow split to Membran Expan.
***9**	**Membranes**	Marginal	N/A	Inadequate	Membrane Expansion
***10**	**Filtered Water Line**	Marginal	N/A	Inadequate	Upsize to 24-inch
11	**1 MG Clearwell**	OK	N/A	OK	N/A
***12**	**High Service Suction Line**	Marginal	N/A	Inadequate	Upsize to 30-inch
***13**	**High Service Pump Station**	OK	N/A	Marginal	N/A

* Denotes improvements which are excluded from this project

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PROPOSED 2017 IMPROVEMENTS

EXHIBIT 5

The analysis for the 6 mgd plant size (5.5 mgd based on membrane flux rate) indicates that the critical improvement to improve the plant to 5.5 mgd capacity is to construct a new San Marcos River take-out structure, pump station and pipeline to the existing pump vault to lift raw water to the plant water clarifiers. These critical improvements are part of the 2017 Texas Water Development Board Improvement Project.

However, there are some items that have been identified as needed improvements to protect the investment that has been made in the HCWTP, improve operation efficiency and support the potential addition of 1.4 mgd of raw water from the City of San Marcos and Martindale WSC.

Another factor that impacts the operation of the HCWTP is recent expansion of the San Marcos City Limit toward the HCWTP. While the HCWTP is not in the City Limits, the HCWTP is now within the Extraterritorial Jurisdiction (ETJ) of San Marcos as provided for in the Texas Local Government Code. San Marcos has land development and flood plain ordinance that apply in the ETJ and the HCWTP is now subject to those regulations. Impacts to the HCWTP include:

- Water Quality Zone (100-foot wide) parallel to the San Marcos River FEMA defined floodway
- Water Quality Buffer Zone (100 feet wide) parallel to the Water Quality Zone
- Impervious Cover Limits
- An adopted 100-year flood elevation at the site that exceeds the elevation in the current effective FEMA floodplain maps
- Floodplain development permitting
- Subdivision platting and associated requirements for driveway connections to public roads
- Runoff detention and stormwater quality treatment to reduce off-site flood impacts and water quality degradation

Thus, when improvements are made at the HCWTP, the above issues require permitting by the City of the proposed improvements.

Exhibit 6 presents a map showing the location of the Water Quality Zone and the Water Quality Buffer Zone as described by the City of San Marcos. These two zones include a significant part of the WCWTP site and will impact future improvements and increase cost.

From the results of the water source analysis, the plant hydraulic evaluation, discussions with CRWA management and staff and the changes caused by the HCWTP now being in the ETJ of

SCALE: 1"=30'

0 30' 60'

22"x34" SCALE: 1"=30'
11"x17" SCALE: 1"=60'

NOTE: AREA OUTSIDE FEMA FLOODWAY AND 100-FT WATER QUALITY ZONE IS IN THE WATER QUALITY BUFFER ZONE.

LEGEND

- WATER
- TREATED WATER
- REJECTED WATER
- SLUDGE LINE
- PROCESS WATER RETURN
- IRRIGATION
- CHLORINE
- CHLORINE DIOXIDE
- SETTLED WATER
- DRAIN
- FILTERED WATER
- RAW WATER
- BACKWASH SUPPLY
- ALUM
- LIQUID AMMONIUM SULFATE
- UNDERGROUND ELECTRIC
- OVERHEAD ELECTRIC
- EXISTING
- DEMO

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CITY OF SAN MARCOS
WATERSHED PROTECTION BOUNDARIES

EXHIBIT 6

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San Marcos, several infrastructure and operational additions and improvements have been identified and are recommended for implementation by CRWA. The priority for the improvements is indicated by their place in the flowing list:

- Construct flood wall (increase plant reliability and protect investment)
- Construct a new decant and water recycle system (improve operational efficiency and reduce cost)
- Replace existing hydraulically-deficient piping and pumps (reduce operation cost and increase reliability)
- Construct a new raw water clarifier (improve plant efficiency and provide operational redundancy)
- Construct new finished water storage tank (improve plant efficiency and provide operational redundancy)
- Acquire adjacent tract (improve operational efficiency, secure plant site and have additional area to assist in meeting San Marcos Development Code requirements)
- Construct new water transmission pipeline to serve County Line SUD, Martindale WSC and Maxwell WSC (operational efficiency and increase system reliability)
- Construct new water transmission pipeline to serve San Marcos (operational efficiency and increase system reliability)

Section 5
Construct Flood Wall

The HCWTP sits on the bank of the San Marcos River and a large portion of the site has been mapped as being subject to riverine flooding from the 100-year flood event on the San Marcos River (see **Exhibits 4 and 6**). These flood boundaries represent regulatory requirements for new construction at the site. In general, the requirement is to avoid new structures in the floodway and the water quality zone and if structures are built within the floodplain boundary, they must not impede the flow of floodwaters, increase floodwater elevations and the lowest floor in the structure must be a minimum of one foot above the 100-year flood elevation.

However, a significant flood event occurred at the HCWTP site on May 15, 2015, when floodwater from primarily the Blanco River watershed flooded out of its banks and created sheet flow across the site that combined with floodwater from the San Marcos River, flooded the HCWTP and water entered several of the structures at the HCWTP. Of critical concern was the potential flooding of the electrical and instrumentation equipment for the plant.

If the equipment had been damaged by the floodwater, the plant would have been out of service and the retail water supply entities taking water from the plant would not be able to adequately serve their customers for days or weeks until replacement equipment could have been installed. In addition, the cost of the repairs, replacements and clean-up could exceed one million dollars.

Keeping the plant safe from flooding so that it can operate during and immediately after flood events is critical to preventing low water pressures, contamination of water lines by polluted

water and to assist in rescue, recovery and clean-up after the storm. There is an existing stand-alone power generation unit at the site to support operation of the plant if a power interruption occurs in the Bluebonnet Electric Cooperative service to the site.

As presented in **Exhibit 7**, a flood wall is proposed for construction to protect the plant site from the 100-year flood event. The proposed flood wall would be placed around the existing water production facilities at the site and proposed additions in the 2017 improvement program.

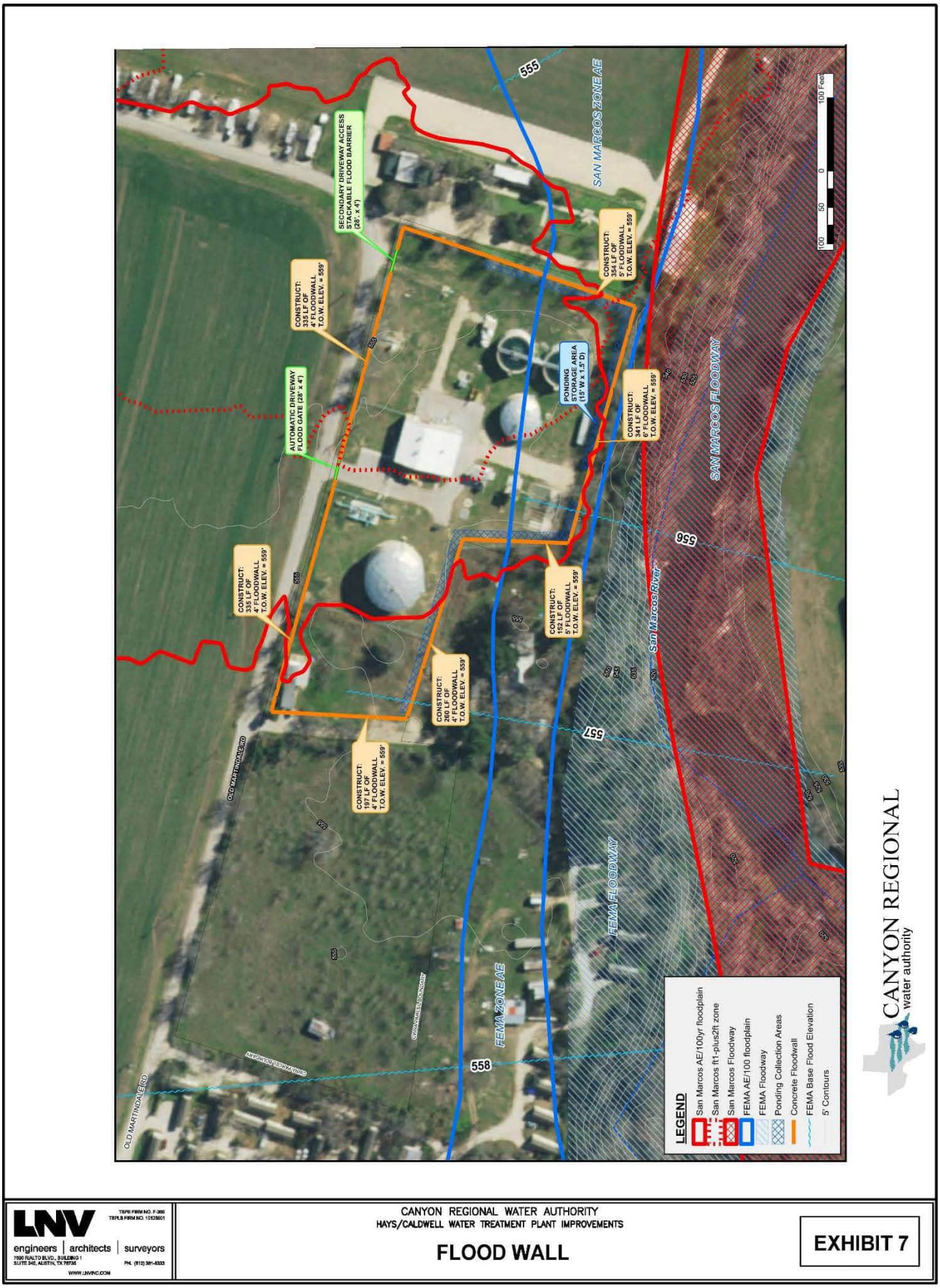
The wall proposed will be constructed of concrete with a minimum of two movable gates to provide access into the site. The proposed wall is targeted to have a top of wall elevation of 559.0 feet above mean sea level. The targeted top of wall elevation should provide a minimum of three feet of freeboard to meet regulatory requirements.

The wall will be designed as a retaining wall imbedded in earth an adequate depth to prevent piping under the wall and with footers as needed to prevent the wall from sliding or overturning during flood events.

Management of rainfall that falls within the flood wall is required during non-flood events and flood events. Two methods to manage the stormwater were investigated.

The first method involves passes to flood water through the wall and letting it flow to the San Marcos River. A series of drainage pipes with flap gates would allow floodwater to pass through the wall during non-flood rainfall events. A stormwater pump station would be required to lift the stormwater through the wall during flood events.

Regulatory requirements will result in a water detention pond within the floodwall to reduce stormwater peak flows from the site and to provide water quality treatment to mitigate for impervious cover. To meet these requirements a stormwater storage pond will be constructed on the down-slope side of the plant site next to the flood wall. Approximately 2.1 acres will be within the floodwall (depending on final alignment adjustments) and the pump station will be sized to move 20 cubic feet per second (cfs) or 9,000 gallons per minute.


SECONDARY DRIVEWAY ACCESS STACKABLE FLOOD BARRIER (28' x 4')
CONSTRUCT: 335 LF OF 4' FLOODWALL T.O.W. ELEV. = 559'
AUTOMATIC DRIVEWAY FLOOD GATE (28' x 4')
CONSTRUCT: 335 LF OF 4' FLOODWALL T.O.W. ELEV. = 559'
CONSTRUCT: 197 LF OF 4' FLOODWALL T.O.W. ELEV. = 559'
CONSTRUCT: 260 LF OF 4' FLOODWALL T.O.W. ELEV. = 559'
CONSTRUCT: 152 LF OF 5' FLOODWALL T.O.W. ELEV. = 559'
PONDING COLLECTION AREA (15' W x 1.5' D)
CONSTRUCT: 341 LF OF 6' FLOODWALL T.O.W. ELEV. = 559'
CONSTRUCT: 314 LF OF 5' FLOODWALL T.O.W. ELEV. = 559'
SAN MARCOS ZONE AE
SAN MARCOS FLOODWAY
San Marcos River
FEMA FLOODWAY
FEMA ZONE AE
OLD MARTINDALE RD
555
556
557
558
559
LEGEND
San Marcos AE/100yr floodplain
San Marcos ft1-plus2ft zone
San Marcos Floodway
FEMA AE/100 floodplain
FEMA Floodway
Ponding Collection Areas
Concrete Floodwall
FEMA Base Flood Elevation
5' Contours
100 Feet
100 50 0
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FLOOD WALL
EXHIBIT 7

For Method One of stormwater disposal, the gravity flow and pumped flow past the floodwater will be point discharges and the flow must be dispersed and dropped to the San Marcos River without eroding the steep river bank.

Method Two for internal stormwater disposal involves capturing the stormwater and letting it flow by gravity during non-flood periods or pumping during flood events to the wet well to be constructed for the new raw water intake. This method of disposal would be an innovative approach to stormwater use and prevent the need for point discharges to the San Marcos River. The stormwater would be passed through a rock and sand filter prior to entering the wet well.

Use of Method Two would require coordination and approval by the TCEQ for water rights and water quality. Best management practices would need to be implemented within the flood wall to manage pollutant generation, remove grass clippings and use of natural fertilizers.

The approval and permitting of the flood wall will require that hydraulic modeling be performed and submitted to FEMA or the authorized cooperating partner. To be approved, the Conditional Letter of Map Revision (CLOMR) submitted must show no significant impact by the flood wall to flood levels. Once approved and the flood wall is constructed, a final Letter of Map Revision (LOMR) must be submitted.

The Texas Historical Commission requires that excavation at the site be monitored by a trained archaeologist for indications of historic artifacts. If there are findings, the construction could be delayed pending resolution of the concerns around a specific find.

Table 3 presents the opinion of probable construction cost (OPCC) for the flood wall. The OPCC is $1,993,400 and includes a 30 percent contingency.

Section 6
New Water Decant and Recycle System

The current filter backwash and sludge waste from the two existing clarifiers is pumped to a plate separator and then passed to decant ponds for solids settling prior to the decanted water being pumped back to the clarifier headworks. The settled solids are accumulated and hauled to an authorized landfill by a contracted and licensed hauler.

The plate separator has not been effective and the existing decant ponds are undersized for current and future flows. This results in solid being pumped back to the clarifier headworks and subsequent build-up of solids in the raw water flow stream. The build-up of solids impacts the performance of the membranes by lowered efficiency and causing more backwash from the membranes to go back to the clarifier headworks. In addition, the build-up of recycled solids impacts the quality of water produced and could cause interference with the water disinfection chemicals that could lead to the formation of water treatment disinfection by-products.

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TABLE 3

Project: Hays/Caldwell WTP Shared Facilities Study
Flood Wall
Project #: 170325

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST					
Item	Description	Qty	Unit	Unit Price	Total Price
1	Mobilization/Demobilization	1	LS	$ 90,600	$ 90,600
2	Concrete Flood Wall	2,029	LF	$ 400	$ 811,600
3	Collection Channel Excavation and Hauling	1,000	CY	$ 20	$ 20,000
4	Static Flood Wall Gate	1	LS	$ 25,000	$ 25,000
5	Automatic Flood Wall Gate	1	LS	$ 75,000	$ 75,000
6	36" Diameter Stormwater Pipe	80	LF	$ 150	$ 12,000
7	24" Automated Gate for Drain Pipe	1	LS	$ 25,000	$ 25,000
8	Rock for Stormwater Filter	20	CY	$ 100	$ 2,000
9	Sand for Stormwater Filter	75	CY	$ 100	$ 7,500
10	Concrete Vault for Pumps	33	CY	$ 500	$ 16,500
11	Two 40-Horsepower Stormwater Pumps	2	EA	$ 30,000	$ 60,000
12	18" Force Main to Wet Well	100	LF	$ 120	$ 12,000
13	Electrical, Instrumentation, SCADA	1	LS	$ 50,000	$ 50,000
				SUB TOTAL	**$ 1,207,200**
			30%	**CONTINGENCY**	**$ 362,200**
				TOTAL PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST (2019 $)	**$ 1,569,400**
	DESIGN	10.0%			$ 157,000
	ADDITIONAL SERVICES	5.0%			$ 78,500
	CONSTRUCTION MONITORING	5.0%			$ 78,500
	ARCHAEOLOGICAL MONITORING	0.5%			$ 7,900
	PERMITTING	4.0%			$ 62,800
	TESTING	1.0%			$ 15,700
	BOND INSURANCE	1.0%			$ 15,700
	MISC. (PRINTING, ETC)	0.5%			$ 7,900
				ADMINISTRATIVE SUB TOTAL	**$ 424,000**
				PROJECT TOTAL (2019 $)	**$ 1,993,400**

CRWA estimates that up to ten percent of the water entering the treatment plant is sent to the decant ponds for settlement of solids and recycling back to the clarifier headworks. For a design plant treatment capacity of 6 mgd, 600,000 gallons of water a day will be sent to the decant basins. If the ultimate plant capacity of 12 mgd is implemented, about 1.2 mgd of water would be recycled. For the existing decant system at HCWTP, backwash water from the clarifiers and wasted sludge from the bottom of the clarifiers is sent to the plate separator and decant ponds.

To increase the removal of solids from the recycle flow stream, it is proposed to construct new decant ponds on the western portion of the CRWA tract that is currently unused. The biggest influence on the efficiency of solids removal in the detention time for recycled water to enable the solids to be removed.

The second factor that will improve solids separation is use of a flocculating agent in the decant ponds to promote the formation of aggregated smaller particles (organic and inorganic) and water stable soil aggregates. Use of the flocculation agent will assist in removing visible sediments and materials and reduce water turbidity by removing colloids.

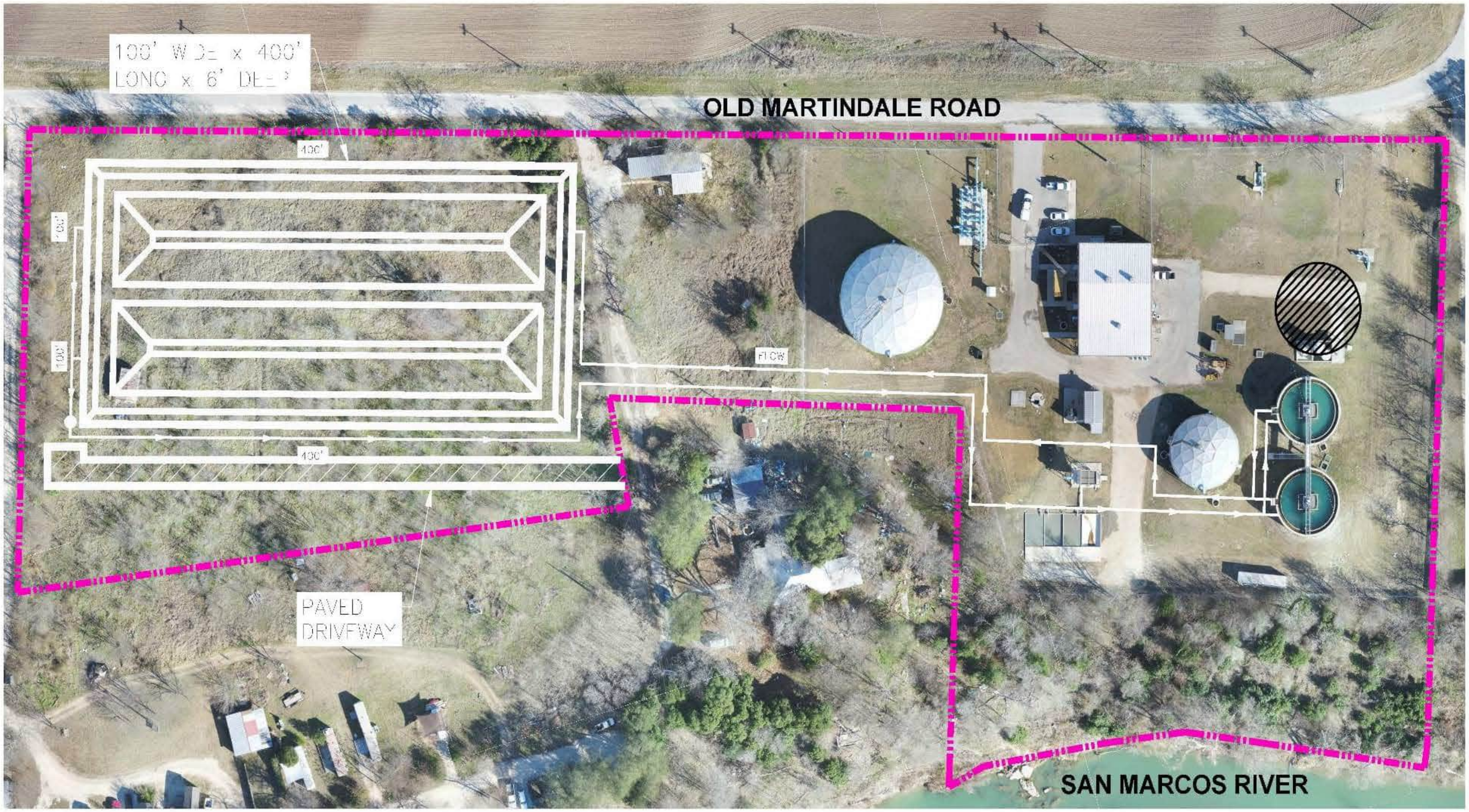
The target detention time for a decant basin is 24 hours and thus a basin would need to hold up to 1.2 million gallons. When flows are smaller than 1.2 mgd, the detention time would increase and additional solids removal will occur.

To enable operational redundancy, two basins are proposed**. Exhibit 8A** shows the configuration of the basins when constructed with earth. Each basin will have a total depth of ten feet from top of embankment to bottom of the pond. The active water depth in the pond would be 7.5 feet with 2.5 feet for freeboard. The proposed length of each pond will be 400 feet with a width of 100 feet (outside to outside dimensions).

The embankments will have a top of crest elevation of 556.0 feet. The embankment side slopes will be three horizontal to one vertical. The outside slope will be protected with riprap to prevent erosion during flood events and the inside will be paved with concrete riprap.

The available storage volume using this configuration is 553,000 gallons for one basin. This is slightly lower than the volume needed for one day of detention at a 6.0 mgd flow rate. With both basins in operation, the storage volume would be 1,106,000 gallons.

New flow lines from the clarifiers to the decant basins will be required and new return flow lines will also need to be constructed. A decant water return flow pump station will also be



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SCALE: 1"=40'

0 40' 80'

22"x34" SCALE: 1"=40'
11"x17" SCALE: 1"=80'

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NEW WATER DECANT & RECYCLE SYSTEM
CONSTRUCTED WITH EARTH

EXHIBIT 8A

needed to send the water back to the clarifier headworks. A new driveway to reach the return water pump station will be constructed.

The City of San Marcos floodplain permitting issues faced by the flood wall, the water quality zone and water quality buffer zone will also need to be addressed for the decant ponds. However, the decant ponds will be “no discharge” to the river structures and should assist in mitigated the impacts of the basins. The archaeological impacts of the construction will also require monitoring.

Table 4 presents the OPCC for the earth basins and is $1,925,300 including a 30 percent contingency.

Exhibit 8B shows the configuration of the basins when constructed with reinforced concrete. Each basin will have a total depth of six feet from top of the wall to the bottom of the pond. The active water depth in the basins would be 4.0 feet with 2.0 feet for freeboard. The proposed length of each pond will be 400 feet with a width of 100 feet (outside to outside dimensions).

The wall will have a top of wall elevation of 555.0 feet. The wall side slopes will be vertical. The outside and inside of the wall is constructed of concrete and thus no protection from floodwater is required. The basins will have concrete bottoms.

The available storage volume using this configuration is 1,196,000 gallons for one basin. This is slightly lower than the volume needed for one day of detention at a 12.0 mgd flow rate. With both basins in operation, the storage volume would be 2,392,000 gallons.

New flow lines from the clarifiers to the decant basins will be required and new return flow lines will also need to be constructed. A decant water return flow pump station will also be constructed.

The City of San Marcos floodplain permitting issues faced by the flood wall, the water quality zone and water quality buffer zone will also need to be addressed for the decant ponds. However, the decant ponds will be “no discharge” to the river structures and should assist in mitigated the impacts of the basins. The archaeological impacts of the construction will also require monitoring.

Table 5 presents the OPCC for the concrete basins and is $4,388,600 including a 30 percent contingency.

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TABLE 4

Project: Hays/Caldwell WTP Shared Facilities Study
New Water Decant and Recycle System with Earth Basins
Project #: 170325

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST					
Item	Description	Qty	Unit	Unit Price	Total Price
1	Mobilization/Demobilization	1	LS	$ 87,500	$ 87,500
2	Basin Excavation and Haul	9,000	CY	$ 20	$ 180,000
3	Compacted Earth Embankment	8,000	CY	$ 20	$ 160,000
4	External Rock Riprap for Slope Protection	60	CY	$ 100	$ 6,000
5	Internal Concrete Rock Riprap Lining	400	CY	$ 450	$ 180,000
6	Decant Piping to Basins, 12"	440	LF	$ 150	$ 66,000
7	Decant Piping Return to Clearwell from Basins, 12"	440	LF	$ 150	$ 66,000
8	Gates for Pipelines, Automated	12	CY	$ 10,000	$ 120,000
9	Backflow Preventers	2	CY	$ 20,000	$ 40,000
10	Concrete Vault for Pumps	50	CY	$ 500	$ 25,000
11	Two 75-Horsepower Stormwater Pumps	2	EA	$ 75,000	$ 150,000
12	Paved Driveway	700	SY	$ 15	$ 10,500
13	Electrical, Instrumentation, SCADA	1	LS	$ 75,000	$ 75,000
				SUB TOTAL	**$ 1,166,000**
			30%	**CONTINGENCY**	**$ 349,800**
				TOTAL PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST (2019 $)	**$ 1,515,800**
	DESIGN	10.0%			$ 151,600
	ADDITIONAL SERVICES	5.0%			$ 75,800
	CONSTRUCTION MONITORING	5.0%			$ 75,800
	ARCHAEOLOGICAL MONITORING	0.5%			$ 7,600
	PERMITTING	4.0%			$ 60,700
	TESTING	1.0%			$ 15,200
	BOND INSURANCE	1.0%			$ 15,200
	MISC. (PRINTING, ETC)	0.5%			$ 7,600
				ADMINISTRATIVE SUB TOTAL	**$ 409,500**
				PROJECT TOTAL (2019 $)	**$ 1,925,300**

OLD MARTINDALE ROAD
SAN MARCOS RIVER
PAVED DRIVEWAY
SCALE: 1"=40'
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HAYS/CALDWELL WATER TREATMENT PLANT IMPROVEMENTS
NEW WATER DECANT & RECYCLE SYSTEM
CONSTRUCTED WITH CONCRETE
EXHIBIT 8B

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TABLE 5

Project: Hays/Caldwell WTP Shared Facilities Study
New Water Decant and Recycle System with Concrete Basins
Project #: 170325

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST					
Item	Description	Qty	Unit	Unit Price	Total Price
1	Mobilization/Demobilization	1	LS	$ 199,400	$ 199,400
2	Basin Excavation and Haul	6,000	CY	$ 20	$ 120,000
3	Concrete Basins (2)	3,200	CY	$ 500	$ 1,600,000
4	External Rock Riprap for Slope Protection	60	CY	$ 100	$ 6,000
5	Internal Concrete Rock Riprap Lining	400	CY	$ 450	$ 180,000
6	Decant Piping to Basins, 12"	440	LF	$ 150	$ 66,000
7	Decant Piping Return to Clearwell from Basins, 12"	440	LF	$ 150	$ 66,000
8	Gates for Pipelines, Automated	12	CY	$ 10,000	$ 120,000
9	Backflow Preventers	2	CY	$ 20,000	$ 40,000
10	Concrete Vault for Pumps	50	CY	$ 500	$ 25,000
11	Two 75-Horsepower Stormwater Pumps	2	EA	$ 75,000	$ 150,000
12	Paved Driveway	700	SY	$ 15	$ 10,500
13	Electrical, Instrumentation, SCADA	1	LS	$ 75,000	$ 75,000
				SUB TOTAL	**$ 2,657,900**
			30%	**CONTINGENCY**	**$ 797,400**
			TOTAL PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST (2019 $)		**$ 3,455,300**
	DESIGN	10.0%			$ 345,600
	ADDITIONAL SERVICES	5.0%			$ 172,800
	CONSTRUCTION MONITORING	5.0%			$ 172,800
	ARCHAEOLOGICAL MONITORING	0.5%			$ 17,300
	PERMITTING	4.0%			$ 138,300
	TESTING	1.0%			$ 34,600
	BOND INSURANCE	1.0%			$ 34,600
	MISC. (PRINTING, ETC)	0.5%			$ 17,300
				ADMINISTRATIVE SUB TOTAL	**$ 933,300**
				PROJECT TOTAL (2019 $)	**$ 4,388,600**

Section 7
Replace Existing Hydraulically Deficient Piping and Pumps

The 2018 Preliminary Engineering Report prepared for the 2017 Texas Water Development Board Project identified piping and pump systems that are hydraulically marginal at a flow rate of 6.0 mgd. It is proposed that those lines and pumps be replaced to improve plant operability and reduce operation cost.

The piping and pumps recommended for replacement are the clarifier flow line from the raw water mixing vault to the clarifiers (100 feet of 24-inch line), membrane influent line (90 feet of 24-inch line), the filtered water line (100 feet of 24-inch line) and the high service pump station suction line (50 feet of 36-inch line). Pump systems needing upgrades are raw water intake (2 new pumps) and the clarifier sludge dump pumps (increase to peak of 7,600 gallons per minute).

The archaeological impacts of the construction will also require monitoring.

Table 6 presents the OPCC for the replacement of the hydraulically deficient piping and pumps and is $1,628,300 including a 30 percent contingency.

Section 8
New Raw Water Clarifier

Exhibit 9 presents the location of a new raw water clarifier that will reduce hydraulic loading to the existing raw water clarifiers and improve the efficiency of the clarifiers. In addition, the third clarifier will enable some operational flexibility for taking a clarifier out of service for repair and cleaning.

The proposed new raw water clarifier will have a 70-foot diameter, and a loading rate of 0.6 gallons per square foot. Thus, the flow-through capacity of the clarifier would be 3.3 mgd. The clarifier would be a concrete basin with attendant yard piping, electrical service, SCADA, skimmer, sludge rake, scum collection and bridge and walkway.

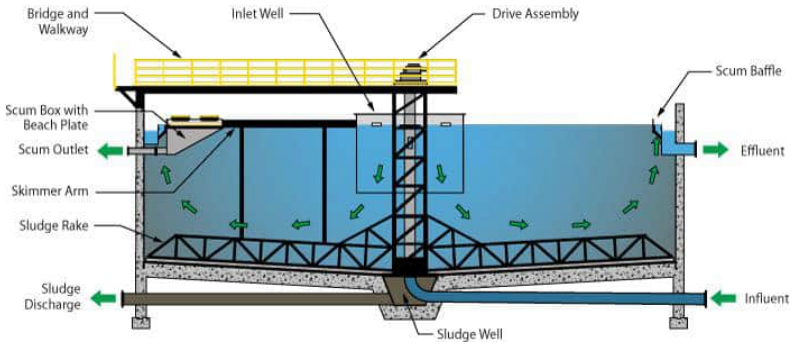

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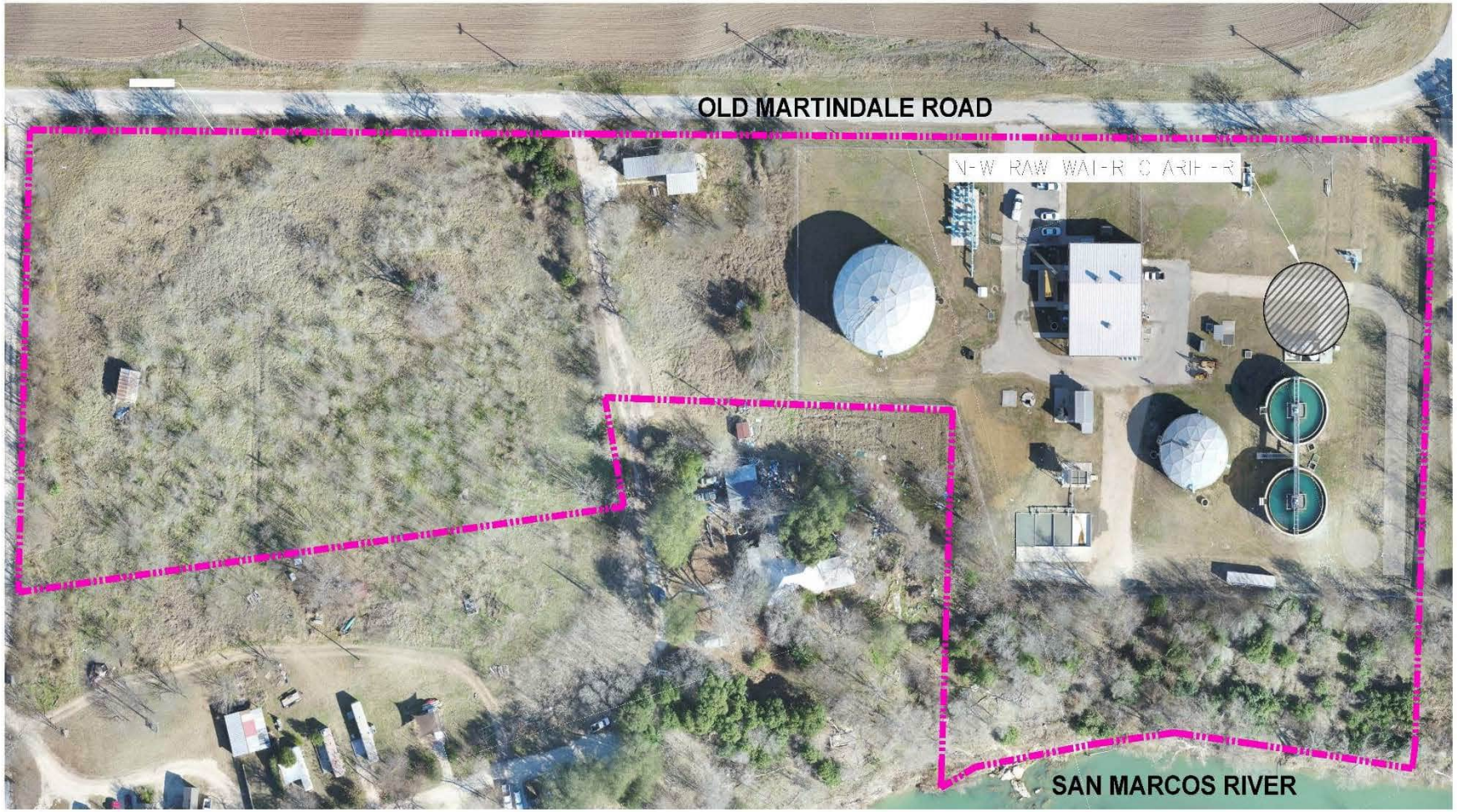
TABLE 6

Project: Hays/Caldwell WTP Shared Facilities Study
Replace Existing Hydraulically Deficient Piping and Pumps
Project #: 170325

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST

Item	Description	Qty	Unit	Unit Price	Total Price
1	Mobilization/Demobilization	1	LS	$ 74,000	$ 74,000
2	Line from Raw Water Mixing Vault to Clarifiers, 24" diameter	100	LF	$ 300	$ 30,000
3	Membrane Influent Line, 24" diameter	90	LF	$ 300	$ 27,000
4	Filtered Water Line, 24" diameter	100	LF	$ 300	$ 30,000
5	High Service Pump Station Suction Line, 30" diameter	50	LF	$ 500	$ 25,000
6	Raw Water Pumps	2	EA	$ 200,000	$ 400,000
7	Decant pumps to and from ponds	4	EA	$ 100,000	$ 400,000
				SUB TOTAL	**$ 986,000**
			30%	**CONTINGENCY**	**$ 295,800**
				TOTAL PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST (2019 $)	**$ 1,281,800**
	DESIGN	10.0%			$ 128,200
	ADDITIONAL SERVICES	5.0%			$ 64,100
	CONSTRUCTION MONITORING	5.0%			$ 64,100
	ARCHAEOLOGICAL MONITORING	0.5%			$ 6,500
	PERMITTING	4.0%			$ 51,300
	TESTING	1.0%			$ 12,900
	BOND INSURANCE	1.0%			$ 12,900
	MISC. (PRINTING, ETC)	0.5%			$ 6,500
				ADMINISTRATIVE SUB TOTAL	**$ 346,500**
				PROJECT TOTAL (2019 $)	**$ 1,628,300**



SCALE: 1"=40'

0 40' 80'

22"x34" SCALE:1"=40'
11"x17" SCALE:1"=80'

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HAYS/CALDWELL WATER TREATMENT PLANT IMPROVEMENTS

NEW RAW WATER CLARIFIER

EXHIBIT 9

S:\Projects\Canyon Regional Water Authority\170100 Hays Caldwell Water Treatment Plant\000\Drawings\Exhibits - Imagery\BOUNDARY EXHIBIT.dwg
Monday, April 15, 2019, 11:32am

The City of San Marcos floodplain permitting issues faced by the flood wall, the water quality zone and water quality buffer zone will also need to be addressed for the new clarifier. However, the clarifier will be a "no discharge" to the river structure and should assist in mitigated the impacts of the clarifier. The archaeological impacts of the construction will also require monitoring.

Table 7 presents the OPCC for the new raw water clarifier and is $2,508,200 including a 30 percent contingency.

Section 9
New Finished Water Storage Tank

Exhibit 10 presents the location of a new proposed 1.0 million-gallon finished water ground storage tank. The new tank will be placed in service to enable retirement of the existing bolted steel tank at the site. The existing bolted steel tank needs repairs and some work is planned to rehabilitate the tank to keep it in service for a limited time. A concern is the potential impact of residual ozone in the finished water that will attack the metal and sealants for the bolted steel tank and lead to leaks and tank failure.

The new finished water storage tank will then work in tandem with the new storage tank in the 2017 bond improvement project to provide redundancy and operation flexibility. In addition, with two million gallons of potential finished water storage, plant production could be curtailed for power outages or emergency repairs.

The City of San Marcos floodplain permitting issues faced by the flood wall, the water quality zone and water quality buffer zone will also need to be addressed for the new ground storage tank. The archaeological impacts of the construction will also require monitoring.

Table 8 presents the OPCC for the new finished water storage tank and is estimated as $1,954,700 including a 30 percent contingency.

Section 10
Acquire Adjacent Tract

Exhibit 11 outlines the location of an adjacent tract of land that sits on the bank of the San Marcos River that is accessed by crossing through an ingress/egress easement across the HCWTP tract. This easement is a nuisance and impacts the efficient use of the CRWA's tract and increases operational cost. In addition, it is possible that another owner or lessor of the property could use the property for other purposes that would infringe on CRWA's ability to operate.

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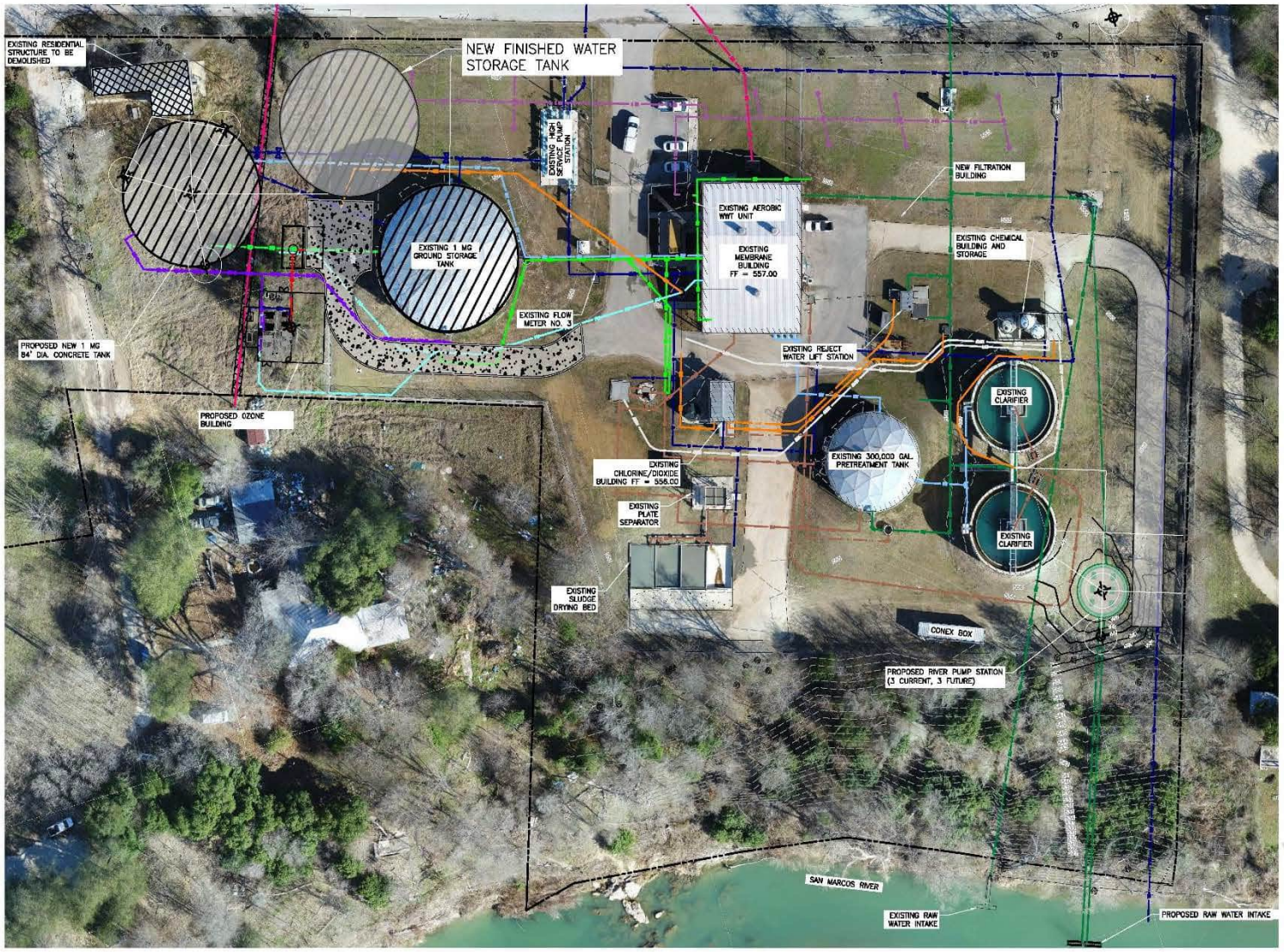
TABLE 7

Project: Hays/Caldwell WTP Shared Facilities Study
New Raw Water Clarifier
Project #: 170325

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST					
Item	Description	Qty	Unit	Unit Price	Total Price
1	Mobilization/Demobilization	1	LS	$ 114,000	$ 114,000
2	New Clarifier, 3.3 mgd	1	LS	$ 1,250,000	$ 1,250,000
3	Influent Piping, 18" diameter	150	LF	$ 300	$ 45,000
4	Effluent Piping, 24" diameter	100	LF	$ 350	$ 35,000
5	Electrical, Instrumentation, SCADA	1	LS	$ 75,000	$ 75,000
				SUB TOTAL	**$ 1,519,000**
			30%	CONTINGENCY	$ 455,700
				TOTAL PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST (2019 $)	**$ 1,974,700**
	DESIGN	10.0%			$ 197,500
	ADDITIONAL SERVICES	5.0%			$ 98,800
	CONSTRUCTION MONITORING	5.0%			$ 98,800
	ARCHAEOLOGICAL MONITORING	0.5%			$ 9,900
	PERMITTING	4.0%			$ 79,000
	TESTING	1.0%			$ 19,800
	BOND INSURANCE	1.0%			$ 19,800
	MISC. (PRINTING, ETC)	0.5%			$ 9,900
				ADMINISTRATIVE SUB TOTAL	**$ 533,500**
				PROJECT TOTAL (2019 $)	**$ 2,508,200**



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NEW FINISHED WATER STORAGE TANK

EXHIBIT 10

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TABLE 8

Project: Hays/Caldwell WTP Shared Facilities Study
New Finished Water Storage Tank
Project #: 170325

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST

Item	Description	Qty	Unit	Unit Price	Total Price
1	Mobilization/Demobilization	1	LS	$ 88,800	$ 88,800
2	New Finished Water Ground Storage Tank, 1 MG, Pre-Stressed Concrete	1	LS	$ 900,000	$ 800,000
3	Foundation Excavation and Haul	1,800	CY	$ 25	$ 45,000
4	Engineered Backfill	2,000	CY	$ 25	$ 50,000
5	Piping, 30-inch diameter	250	CY	$ 300	$ 75,000
6	Gates for Pipelines, Automated	3	EA	$ 25,000	$ 75,000
7	Electrical, Instrumentation, SCADA	1	LS	$ 50,000	$ 50,000
				SUB TOTAL	**$ 1,183,800**
			30%	**CONTINGENCY**	**$ 355,200**
			TOTAL PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST (2019 $)		**$ 1,539,000**
	DESIGN	10.0%			$ 153,900
	ADDITIONAL SERVICES	5.0%			$ 77,000
	CONSTRUCTION MONITORING	5.0%			$ 77,000
	ARCHAEOLOGICAL MONITORING	0.5%			$ 7,700
	PERMITTING	4.0%			$ 61,600
	TESTING	1.0%			$ 15,400
	BOND INSURANCE	1.0%			$ 15,400
	MISC. (PRINTING, ETC)	0.5%			$ 7,700
				ADMINISTRATIVE SUB TOTAL	**$ 415,700**
				PROJECT TOTAL (2019 $)	**$ 1,954,700**

SCALE: 1"=30'

0 30' 60'

22"x34" SCALE:1"=30'
11"x17" SCALE:1"=60'

LEGEND

- WATER
- TREATED WATER
- REJECTED WATER
- SLUDGE LINE
- PROCESS WATER RETURN
- IRRIGATION
- CHLORINE
- CHLORINE DIOXIDE
- SETTLED WATER
- DRAIN
- FILTERED WATER
- RAW WATER
- BACKWASH SUPPLY
- ALUM
- LIQUID AMMONIUM SULFATE
- UNDERGROUND ELECTRIC
- OVERHEAD ELECTRIC
- EXISTING
- DEMO

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AQUIRE ADJACENT TRACT

EXHIBIT 11

The subject tract is 2.009 acres and was appraised in the records of the Caldwell County Appraisal District at a value of $231,850 in 2018. The Caldwell CAD records report that the main dwelling was built in 1906 and consists of a 2,680 square foot house. The house has three unattached buildings including a garage, storage utility building and shed.

The easement crossing the CRWA tract must always be uncontrolled and impacts the ongoing 2017 projects and future projects. Because of the house proximity to the San Marcos River, it is in the 100-year floodplain of the river and the water quality zone established by the City of San Marcos.

The benefits of CRWA purchasing the tract include:

- Extinguishing the driveway easement across the HCWTP
- Increased usability of the CRWA tract
- Increased operation efficiency
- Protection from a third part using the adjacent tract for other purposes
- Having additional buffer from residences
- Improves facility siting and development
- Provides additional area that will not be built on that can lower impervious cover percentage
- The undeveloped portions of the tract can be used as a vegetated filter strip
- Eliminating the 450 feet of fence and gates that will be built along the access easement

The reasons for CRWA not purchasing the tract include:

- Cost of acquisition
- About 370 feet of fence required to fence the tract
- Possible house would be designated a historic structure
- Cost of demolishing the house and other structures and restoring the site

Table 9 presents the OPCC to purchase the adjacent tract and is estimated as $375,000 with a 30 percent contingency.

Section 11
Treated Water Distribution

Exhibit 12 presents the location of new proposed water transmission lines, a new high service pump station and a new 500,000-gallon elevated storage tank that will be used to convey water to the users of the water treated at the HCWTP. The existing water transmission line sending

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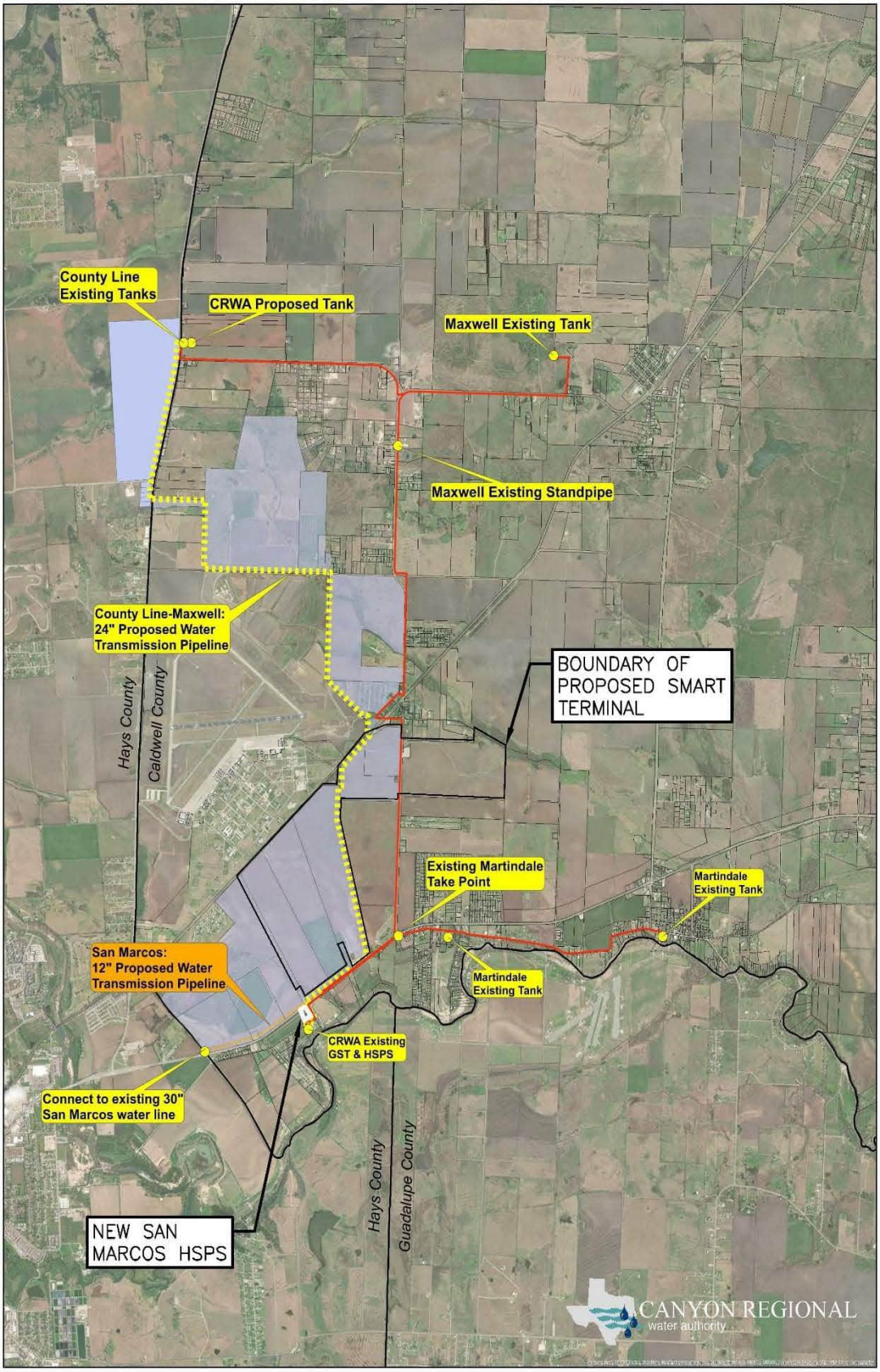
TABLE 9

Project: Hays/Caldwell WTP Shared Facilities Study
Purchase Adjacent Tract
Project #: 170325

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST

Item	Description	Qty	Unit	Unit Price	Total Price
1	Land Purchase, 2.009-acre Tract	1	LS	$ 231,800	$ 231,800
2	Structure Demolition and Site Cleaning	1	LS	$ 25,000	$ 25,000
3	Additional Fencing	350	LF	$ 25	$ 8,750
4	Real Estate Fee	1	LS	$ 15,000	$ 15,000
5	Closing Cost	1	LS	$ 5,000	$ 5,000
				SUB TOTAL	**$ 285,550**
				30% CONTINGENCY	**$ 85,700**
			TOTAL PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST (2019 $)		**$ 371,250**
	DESIGN	0.0%			$ -
	ADDITIONAL SERVICES	1.0%			$ 3,800
	CONSTRUCTION MONITORING	0.0%			$ -
	ARCHAEOLOGICAL MONITORING	0.0%			$ -
	PERMITTING	0.0%			$ -
	TESTING	0.0%			$ -
	BOND INSURANCE	0.0%			$ -
	MISC. (PRINTING, ETC)	0.0%			$ -
				ADMINISTRATIVE SUB TOTAL	**$ 3,800**
				PROJECT TOTAL (2019 $)	**$ 375,050**



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CANYON REGIONAL WATER AUTHORITY
HAYS/CALDWELL WATER TREATMENT PLANT IMPROVEMENTS

PROPOSED WATER TRANSMISSION LINES

EXHIBIT 12

treated water to Martindale WSC, Maxwell WSC and County Line SUD has operational issues with undersized lines, bottlenecks and has experienced numerous pipe breaks.

County Line SUD takes water from the existing Maxwell WSC line and needs to increase the reliability of service with a new right-sized line. Maxwell WSC will be able to connect to the new pipeline in several locations and will be able to convert their existing line to a distribution line that could operate at lower pressures and flow rates.

The proposed 24-inch diameter, 36,000 linear foot long water transmission pipeline would serve Martindale WSC, Maxwell WSC and County Line SUD. The line could be constructed of concrete-lined steel cylinder pipe, PVC pipe or ductile iron depending on ultimate design and pricing at construction bid time. The sizing of the new line will allow the 5.5 mgd flow to be sent to County Line SUD and Maxwell WSC if needed.

The proposed 12-inch diameter, 5,800 linear foot long water transmission pipeline would serve the City of San Marcos. The line could be constructed of PVC pipe or ductile iron depending on ultimate design and pricing at construction bid time. The sizing of the new line will convey the 1.04 mgd dedicated to the City with the ability to peak flow up to about 1.5 the average capacity.

The proposed 500,000-gallon elevated storage tank at the terminal end of the County Line SUD and Maxwell WSC line will provide pressure stability to the pipeline for operating purposes and to enable delivery of water if there are line breaks or power outages.

The proposed high service pump station to serve the City of San Marcos pipeline will be sized to move 1.5 mgd (a peaking factor of 1.5). The water line will connect to an existing 30-inch diameter line and be fitted with valving and backflow preventers to protect both systems. The meter for measuring flow will be at HCWTP.

The archaeological impacts of the construction will also require monitoring.

Easements will need to be obtained for the pipeline route. The recommended easement width will be 60 feet with parallel temporary construction easements where needed. Pipelines under roadways will be bored and with casing and carrier pipes. Environmental assessments and permitting will be completed to identify and where appropriate, mitigate any identified issues.

Table 10 presents the opinion of probable construction cost (OPCC) for the County Line SUD and Maxwell WSC pipeline and associated elevated storage tank. The OPCC is $12,811,300 and includes a 30 percent contingency.

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TABLE 10

Project: Hays/Caldwell WTP Shared Facilities Study
County Line SUD and Maxwell WSC Pipeline
Project #: 170325

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST					
Item	Description	Qty	Unit	Unit Price	Total Price
1	Mobilization/Demobilization	1	LS	$ 582,000	$ 582,000
2	Connection to Existing Pump Station	1	LS	$ 25,000	$ 750,000
3	24" Pipeline	36,000	LF	$ 120	$ 4,320,000
4	Connection to Existing Martindale Line	1	LS	$ 25,000	$ 25,000
5	Boring, Casing Under Roadways and Railway	1,000	LF	$ 600	$ 600,000
6	Gate Valves	12	EA	$ 25,000	$ 300,000
7	Elevated Storage Tank, 500,000 Gallon	1	EA	$ 500,000	$ 500,000
8	Connection to Existing County Line System	1	EA	$ 25,000	$ 25,000
9	Flow Measuring Meter	3	EA	$ 10,000	$ 30,000
10	Easements	49	AC	$ 10,000	$ 490,000
11	Land Purchase for Elevated Storage Tank	2	AC	$ 25,000	$ 37,500
12	Electrical, Instrumentation, SCADA	1	LS	$ 100,000	$ 100,000
				SUB TOTAL	**$ 7,759,500**
			30%	**CONTINGENCY**	**$ 2,327,900**
				TOTAL PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST (2019 $)	**$ 10,087,400**
	DESIGN	10.0%			$ 1,008,800
	ADDITIONAL SERVICES	5.0%			$ 504,400
	CONSTRUCTION MONITORING	5.0%			$ 504,400
	ARCHAEOLOGICAL MONITORING	0.5%			$ 50,500
	PERMITTING	4.0%			$ 403,500
	TESTING	1.0%			$ 100,900
	BOND INSURANCE	1.0%			$ 100,900
	MISC. (PRINTING, ETC)	0.5%			$ 50,500
				ADMINISTRATIVE SUB TOTAL	**$ 2,723,900**
				PROJECT TOTAL (2019 $)	**$ 12,811,300**

Table 11 presents the opinion of probable construction cost (OPCC) for the City of San Marcos pipeline. The OPCC is $3,525,000 and includes a 30 percent contingency.

Section 12
Existing and Future Infrastructure Buy-In

The existing infrastructure for the HCWTP has been paid and is being paid for through a series on bond sales and internally generated capital. These funds are considered as capital assets and are subject to depreciation based on their assigned useful life. The net book value for these assets represents the "buy-in" of plant capacity if another entity wanted to join the group and benefit from the investments that have been made by others.

The cost of future improvements would be shared by the project participants based on their percentage of the total plant contracts. Participants could sell or lease their interest to other members of the group, but the payment responsibility would remain with the original borrowers unless amendments to the financing documents are agreed to.

Operation and maintenance costs are estimated on an annual basis and include a fixed rate plus a variable rate. Operation and maintenance costs are not capital assets and thus are not part of a buy-in calculation.

Table 12 presents a summary of the HCWTP asset plant cost and the net book value as on 2019. The depreciation is on a straight-line basis and are the dates are the year of installation. The Net Book Value of the Assets in 2019 is $11,585,676.

Table 13 presents the cost per acre-foot of water committed to the plant for treatment (based on plant contracts). This calculation does not include the potential additional water from the City of San Marcos and Martindale WSC.

Table 14 presents the cost per acre-foot of water committed to the plant for treatment. The calculation presented assumes that the City of San Marcos and Martindale WSC commit a total of 1.40 mgd of new raw water to the plant (1,569.84 acre-feet per year).

Table 15 presents the share on ownership in the plant based on a total of 4,468 acre-feet of water per year. Also presented is the new cost of the plant capacity for each entity.

Table 16 presents the cost for buy-in for the City of San Marcos and Martindale WSC commit to add 1,314 acre-feet per year and an additional 255.84 acre-feet per year respectively to the HCWTP.

Table 17 presents the annual cost for buy-in if the buy-in is financed for 20, 25 or 30 years. The annual interest rate is assumed to be 4.0 percent.

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TABLE 11

Project: Hays/Caldwell WTP Shared Facilities Study
San Marcos Water Distribution Pipeline
Project #: 170325

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST

Item	Description	Qty	Unit	Unit Price	Total Price
1	Mobilization/Demobilization	1	LS	$ 160,200	$ 160,200
2	High Service Pump Station, 1.5 mgd Capacity	1	LS	$ 750,000	$ 750,000
3	Pipe Connection to Tank, 24" diameter	100	LF	$ 300	$ 30,000
4	Distribution Pipeline, 12-inch diameter	5,800	CY	$ 125	$ 725,000
5	Boring, Casing Under Roadways	200	LF	$ 600	$ 120,000
6	Gate Valves	5	EA	$ 20,000	$ 100,000
7	Connection to Existing 30" Line	1	EA	$ 25,000	$ 25,000
8	Gate Valves for Existing 30" Line	2	EA	$ 30,000	$ 60,000
9	Flow Measuring Meter	1	EA	$ 10,000	$ 10,000
10	Easements	8	AC	$ 10,000	$ 80,000
11	Electrical, Instrumentation, SCADA	1	LS	$ 75,000	$ 75,000
				SUB TOTAL	**$ 2,135,200**
			30%	**CONTINGENCY**	**$ 640,600**
				TOTAL PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST (2019 $)	**$ 2,775,800**
	DESIGN	10.0%			$ 277,600
	ADDITIONAL SERVICES	5.0%			$ 138,800
	CONSTRUCTION MONITORING	5.0%			$ 138,800
	ARCHAEOLOGICAL MONITORING	0.5%			$ 13,900
	PERMITTING	4.0%			$ 111,100
	TESTING	1.0%			$ 27,800
	BOND INSURANCE	1.0%			$ 27,800
	MISC. (PRINTING, ETC)	0.5%			$ 13,900
				ADMINISTRATIVE SUB TOTAL	**$ 749,700**
				PROJECT TOTAL (2019 $)	**$ 3,525,500**

TABLE 12 INVESTMENT, DEPRECIATION AND NET BOOK VALUE OF HAYS CALDWELL WATER TREATMENT PLANT ASSETS					
ORIGINAL COST	INSTALL YEAR	ORIGINAL COST	USEFUL LIFE, YEARS	ACCUMULATED DEPRECIATION	NET BOOK VALUE
HAYS CALDWELL - PHASE I					
Construction Costs	2002	$6,298,725	50	$2,141,567	$4,157,159
Capitalized Interest	2002	$1,047,705	50	$356,220	$691,485
Land Purchase	2002	$290,838	Not Applicable	$290,838	$290,838
Improvements	2005	$16,814	30	$7,847	$8,967
TOTAL		$7,654,082		$2,796,471	$5,148,449
HAYS CALDWELL - PHASE II					
Plant Expansion	2006	$1,560,824	50	$405,814	$1,155,010
Pumps and Equipment	2008	$470,941	25	$207,214	$263,727
Portable Building	2009	$8,468	10	$8,468	$0
Operating Equipment	2010	$3,933	10	$3,540	$393
Operating Equipment	2017	$26,828	5	$10,731	$16,097
TOTAL		$2,070,994		$635,767	$1,435,227
PLANT IMPROVEMENTS 2017					
Plant Improvements	2019	$5,000,000	50	$0	$5,000,000
TOTAL PLANT COSTS		$14,725,076		$3,432,238	$11,583,676

TABLE 13

PER ACRE-FOOT REMAINING COST OF WATER COMMITTED TO THE PLANT BY CURRENT PARTICIPANTS WITHOUT SAN MARCOS AND ADDITIONAL WATER FROM MARTINDALE WSC

PARTICIPANT	PLANT CONTRACT IN ACRE-FEET	PERCENTAGE OF PLANT	NET BOOK VALUE RESPONSIBLE FOR
Crystal Clear SUD	500	17.194	$1,991,691
County Line SUD	1,308	44.9794	$5,210,264
Martindale WSC	200	6.8776	$796,676
Maxwell WSC	900	30.949	$3,585,044
TOTAL	2,908	100.000	$11,583,676

TABLE 14 PER ACRE-FOOT REMAINING COST OF WATER COMMITTED TO THE PLANT BY CURRENT PARTICIPANTS, SAN MARCOS AND ADDITIONAL WATER FROM MARTINDALE WSC			
PARTICIPANT	PLANT CONTRACT IN ACRE-FEET	PERCENTAGE OF PLANT	NET BOOK VALUE RESPONSIBLE FOR
Crystal Clear SUD	500	11.191	$1,296,293
County Line SUD	1,308	29.2748	$3,391,103
Martindale WSC	446	9.9821	$1,156,294
Maxwell WSC	900	20.143	$2,333,328
City of San Marcos	1,314	29.409	$3,406,659
TOTAL	4,468	100.000	$11,583,676

TABLE 15

PER ACRE-FOOT REMAINING COST OF WATER COMMITTED TO THE PLANT BY CURRENT PARTICIPANTS AND SAN MARCOS

PARTICIPANT	PLANT CONTRACT IN ACRE-FEET	PERCENTAGE OF PLANT	NET BOOK VALUE RESPONSIBLE FOR
Crystal Clear SUD	500	11.843	$1,371,823
County Line SUD	1,308	30.9806	$3,588,690
Martindale WSC	200	4.7371	$548,729
Maxwell WSC	900	21.317	$2,469,282
City of San Marcos	1,314	31.123	$3,605,152
TOTAL	4,222	100.000	$11,583,676

TABLE 16

SUMMARY OF BUY-IN COST FOR SAN MARCOS AND ADDITIONAL MARTINDALE WATER (EXISTING PLANT)

ITEM	BUY-IN TOTAL	ACRE-FEET	COST PER ACRE-FOOT
SAN MARCOS AND ADDITIONAL MARTINDALE WATER			
Additional Martindale WSC	$359,618	246	$1,462
City of San Marcos	$3,406,659	1,314	$2,593
SAN MARCOS ONLY			
City of San Marcos	$3,613,574	1,314	$2,750

TABLE 17

AMORTIZED COST OF BUY-IN WATER AT 4.0 PERCENT ANNUAL INTEREST RATE (EXISTING PLANT)

ITEM	BUY-IN TOTAL	TERM, YEARS	ANNUAL PAYMENT, 20-YEAR TERM	ANNUAL COST OF WATER PER ACRE-FOOT (20-YEAR)	TERM, YEARS	ANNUAL PAYMENT, 25-YEAR TERM	ANNUAL COST OF WATER PER ACRE-FOOT (25-YEAR)	TERM, YEARS	ANNUAL PAYMENT, 30-YEAR TERM	ANNUAL COST OF WATER PER ACRE-FOOT (30-YEAR)
SAN MARCOS AND ADDITIONAL MARTINDALE WATER										
Martindale WSC	$359,618	20	$26,461	$108	25	$23,020	$94	30	$20,797	$85
City of San Marcos	$3,406,659	20	$250,668	$191	25	$218,067	$166	30	$197,007	$150
SAN MARCOS ONLY										
City of San Marcos	$3,613,574	20	$265,893	$202	25	$231,312	$176	30	$208,973	$159

TABLE 18

COST OF PROPOSED IMPROVEMENTS PER PARTICIPANT

PARTICIPANT	PLANT CONTRACT IN ACRE-FEET	PERCENTAGE OF PLANT	SHARE OF PROPOSED COST
Crystal Clear SUD	500	11.191	$1,162,142
County Line SUD	1,308	29.2748	$3,040,163
Martindale WSC	446	9.9821	$1,036,631
Maxwell WSC	900	20.143	$2,091,855
City of San Marcos	1,314	29.409	$3,054,109
TOTAL	4,468	100.000	$10,384,900

TABLE 19

PER ACRE-FOOT COST OF PROPOSED IMPROVEMENTS (WITH SAN MARCOS AND ADDITIONAL MARTINDALE WATER)

ITEM	ACRE-FEET OF WATER	PERCENTAGE OF PLANT	SHARE OF TOTAL COST	PER ACRE-FOOT COST
Crystal Clear SUD	500	11.191	$1,162,142	$2,324
County Line SUD	1,308	29.2748	$3,040,163	$2,324
Martindale WSC	446	9.9821	$1,036,631	$2,324
Maxwell WSC	900	20.143	$2,091,855	$2,324
City of San Marcos	1,314	29.409	$3,054,109	$2,324
TOTAL	4,468	100.000	$10,384,900	$2,324

TABLE 20

AMORTIZED COST OF PROPOSED IMPROVEMENTS AT 4.0 PERCENT ANNUAL INTEREST RATE

ITEM	SHARE OF TOTAL COST	TERM, YEARS	ANNUAL PAYMENT, 20-YEAR TERM	TERM, YEARS	ANNUAL PAYMENT, 25-YEAR TERM	TERM, YEARS	ANNUAL PAYMENT, 30-
Crystal Clear SUD	$1,162,142	20	$85,512	25	$74,391	30	$67,20
County Line SUD	$3,040,163	20	$223,701	25	$194,607	30	$175,81
Martindale WSC	$1,036,631	20	$76,277	25	$66,357	30	$59,94
Maxwell WSC	$2,091,855	20	$153,922	25	$133,904	30	$120,97
City of San Marcos	$3,054,109	20	$224,727	25	$195,500	30	$176,61
TOTAL	$10,384,900	20	$764,139	25	$664,758	30	$600,56
Annual Cost Per Acre-Foot of Water			$171		$149		$13

TECHNICAL MEMORANDUM

Water Capital Improvements Plan Update and Conceptual Cost Opinions

Miscellaneous Water Modeling

City of San Marcos

PREPARED FOR	Shaun Condor, PE City of San Marcos
PREPARED BY	Hannah Leppla, PE (TX No. 130165) Plummer Associates, Inc.
cc	Stephen J. Coonan, PE, Principal
DATE	December 9, 2022
VERSION	1
PROJECT NO.	0600-018-03 Fund Allocation #1
FILE DIRECTORY	\\aus-fs.aus.apai\share\projects\0600\018-01\20220331 fa 1 - cip update\task 2 - cip update\20220622 cip update - fa 1 - task 2.docx

Attachment A CIP List: Conceptual Cost Opinions

Attachment B CIP List: Large Format Map

PLUMMER

Texas Registered Engineering Firm F-13

1 INTRODUCTION

The City of San Marcos (City) completed a Master Plan for its water distribution system in 2016 and an update to that Master Plan in 2020. The purpose of the Master Plan is to guide the growth and development of the distribution system and to prepare a Capital Improvements Plan (CIP) list that would provide the City with a financial strategy for infrastructure improvements.

Since the time of publication of the 2020 Water Master Plan Update, the system has seen several changes, including new development and new pipeline projects, and construction costs in the industry have increased. In addition, the planning horizon for the 2025 projects is closing in and prioritization and details are needed in order to adequately plan for the design and implementation of the 2025 projects.

For these reasons, the City retained Plummer Associates, Inc. (Plummer) to complete an update to the 2020 CIP list for the projects required in the planning horizon and the conceptual cost of each of the remaining projects.

Table 1 presents the CIP cost opinions from the 2020 Water Master Plan Update and Table 2 summarizes the updated conceptual cost opinions for the 2022 construction climate.

Table 1: CIP Cost Opinions (2020)

Infrastructure Type	2025	2030	2035
Pumps / Wells	$ 7,200,000	-	$ 1,234,000
Pipes	$ 14,609,000	$ 12,112,000	$ 5,318,000
Tanks	$ 7,326,000	$ 4,493,000	-
Total	**$ 29,135,000**	**$ 16,605,000**	**$ 6,552,000**

Table 2: Updated CIP Cost Opinions (2022)

Infrastructure Type	2025	2030	2035
Pumps / Wells	$ 1,430,000	-	$ 1,450,000
Pipes	$ 23,220,000	$ 17,750,000	$ 6,390,000
Tanks	$ 5,350,000	$ 200,000	-
Total	**$ 30,000,000**	**$ 17,950,000**	**$ 7,840,000**

2 CIP LIST – 2022 UPDATE

In general, the criteria used to identify the capital improvements needed to serve the projected demand in each target year were as follows:

- State regulatory criteria met for storage and pumping capacity.
- Meeting a target pressure of 35 psi during maximum day demand conditions at all service connections in the distribution system.
- Minimum allowable pressure of 20 psi under fire flow conditions.
- Head loss of less than 7 ft per 1,000 ft. in all pipes.
- Pipe velocities below 7 ft/s during maximum day demand conditions.
- Adequate fire flow availability (including 1,000 gpm for new connections, 500 gpm for existing connections) under maximum day demand conditions; and
- Reducing water age where feasible through looped connections to improve water quality and provide redundant water delivery pathways.

One other goal of the proposed CIP list is to consolidate the 11 existing pressure planes into 3 pressures planes for the entire City distribution system. Fewer pressure planes will provide greater resiliency for previously isolated areas of the system and improve operational controls and simplicity of the controls.

2.1 CIP LIST TRACKED CHANGES

Several model changes have been made to the 2020 model based on new City GIS pipeline data and discussions with the City. The changes are discussed below.

1. CIP #3: Hunter Rd. Parallel – Removed.
    a. Since CIP #4 Southwest 810' Plane Loop will tie in the 810' pressure plane and Hunter Rd. to remain on the 936' pressure plane.
2. CIP #3: Willow Creek Connections to McCarty Pressure Plane – New project.
    a. Two connections between the Willow Creek service area and McCarty pressure plane for redundant water sources for Willow Creek customers (well water from McCarty or surface water through Purgatory PRV).
3. CIP #9: Leah Ave. Extension – Reduced scope due to recent projects and proposed PGM of Texas Roadway Extension.
    a. See new CIP #31 for PGM of Texas Roadway Extension scope.
4. CIP #15: Add SWTP Pump – Removed.
    a. This project is fully funded and in the construction phase.

5. CIP #16: 12" Connection for CRWA – Updated alignment based on conceptual design documents from Freese and Nichols.
    a. Note that CRWA recently requested a potential oversize of this line. If the pipe diameter is increased, the City shall coordinate the decision with Plummer to have the model updated.
6. CIP #22: Kissing Tree - Kingswood Line – Update alignment to connect at Lazy Lane and upsize water line in Lazy Ln. to be 12".
7. CIP #26: Ranch Road 12 Parallel (Comanche Discharge Parallel) – Confirmed that the model was using a 12" diameter (previously identified as 16" diameter project) for the Ranch Road 12 improvements between Holland St. and Craddock Ave.
8. CIP #31: PGM of Texas Extension – Previous version of CIP list had project #31 to be an upgrade of the 12" in Clovis Barker to a 16". New project will leave Clovis Barker as 12" and install new 16" along transportation master plan route as discussed.
9. CIP #34: Northside Connection – Reduced scope to remove second railroad crossing and second IH-35 crossing. The new project will rely upon the completion of the 12" network within the Whisper PID development and then connect to the furthest east end of the Whisper PID network with a new 12". As the 12" travels east, it could follow along the un-developed Whisper parcels though the Maxwell CCN and then follow the extension of William Petus to the west to meet Harris Hill.
10. CIP #35: Post Rd. Connection – Removed from CIP list since model indicates that water can move from the Blanco Vista EST to the southwest through the existing Post Rd. 16" and to the southeast through existing 12" / 16" lines and the new 12" to the east of Whisper PID (CIP #34).
11. CIP #36: Potential 810 Elevated Storage Tank – Removed.
    a. Since additional elevated storage is not required for TCEQ compliance or for operational improvements, this project was re-named to cover the bolted tank rehabilitation project requested by Ron Riggins and Bruce Noel. Intended to cover inspection and rehabilitation of the panels at the RR 12 GST and Comanche Standpipe. Not intended for potential foundation work at Comanche.
    b. The new project name is "Bolted Steel Tank Rehabilitation"
12. CIP #39: Centerpoint Extension – Update scope to be all 12" diameter. The previous project used 16" and 12" to connect from Old Bastrop Hwy. to the recently installed Primrose line.
13. CIP #40: Francis Harris Extension – Scope has been modified to consider the Trace developer's plans along the southeast commercial parcels. Since an 8" tee has already been installed at Snowbell and Old Bastrop Hwy, this extension of the Old Bastrop Hwy. waterline will be all 8" from Poser Rd. to the south bound Francis Harris extension. Additionally, a 12" will be installed by the Trave developer along the central corridor, Esplanade Parkway. New CIP #37.1 and #37.2.

14. CIP #42: McCarty Connection – Removed project from CIP since Crystal Clear 8" in McCarty is now in San Marcos ownership.
15. Maintenance Project #11 – Maintenance and repair data for WL21790 (24" PVC installed in 2002) has had one break in the past and is ranked as "moderate risk" based on the consequence and likelihood of failure evaluation conducted by Kirk Abbott. Maintenance Project #11 is a monitoring request because of the extremely high consequence of failure of this pipeline segment, but no CIP dollars are required to be allocated to this maintenance project. This maintenance project has been removed.

2.2 IMMEDIATE GOALS FOR 2025

1. CIP #1: Comanche Pump Improvements
    a. Design in Process – 90%
2. CIP #3: Willow Creek Connections
    a. Work to be completed by City staff
3. CIP #13: Airport Extension
    a. Construction complete
4. CIP #16: Highway 80 Extension 1
    a. Design in Process – 90%
5. CIP #26: RR 12 Pipeline Parallel
    a. Design in Process – 100%
6. CIP #26: Sessom Drive Improvements
    a. Design in Process – 100%

3 CONCEPTUAL COST OPINIONS

A summary of the updated conceptual cost opinions of the CIP projects is presented below, in Table 3. Detailed cost estimates for each project are included in Attachment A.

Table 3: CIP Conceptual Costs Summary

2022 CIP Number	Year	Project Name	Opinion of Probable Cost
1	2025	Replace Comanche Pumps	$ 2,470,000
1 - P			
2	2025	Replace Soyars Pumps	$ 1,430,000
3	2025	Willow Creek Connections to McCarty Pressure Plane	$ 120,000
4	2025	Southwest 810' Plane Loop	$ 1,450,000
5	2025	Stagecoach Trail Extension	$ 940,000
6	2025	Rattler Road Loop	$ 730,000
7	2025	South Hunter Rd Loop	$ 1,010,000
8	2025	Patricia and Sunset Acres	$ 1,090,000
9	2025	Leah Ave Extension	$ 690,000
10	2025	Upgrade IH-35 Crossings	$ 1,360,000
11	2025	Railroad Crossing and Upgrades near the Conn's shopping center.	$ 1,010,000
12	2025	Big Hat Feed	$ 1,060,000
13	2025	Airport Extension	$ 1,860,000
14	2025	Blanco Vista EST	$ 480,000
14 - T	2025		$ 5,350,000
16	2025	CRWA Interconnect	$ 1,630,000
17 - T	2025	Kissing Tree Tank	*developer cost*
18 - P	2025	Kissing Tree PS	*developer cost*
18			*developer cost*
20	2025	Kissing Tree Loop - Phase 2a	*developer cost*
22	2025	Kissing Tree - Kingswood Line	$ 1,640,000
23	2025	Kissing Tree - Deerwood Line	$ 1,120,000
24	2025	Kissing Tree - McCarty Line	*developer cost*
25	2025	Airport Loop	$ 2,670,000
26	2025	Parallel Comanche Outlet Main	$ 1,890,000

2022 CIP Number	Year	Project Name	Opinion of Probable Cost
27	2030	Kissing Tree - La Cima Loop - Connect to Estates of San Marcos	$ 220,000
28	2030	Kissing Tree - La Cima Loop - Primary	$ 5,360,000
29	2030	McCarty Tank Fill/Drain Line	$ 2,280,000
30	2030	US 80 Loop	$ 2,670,000
31	2030	PGM of Texas Extension	$ 3,060,000
32	2030	Trace Dev. Connection	$ 890,000
33	2030	Old Bastrop Extension 1	$ 310,000
34	2030	North Side Connection for ARWA BV EST Water	$ 1,310,000
36 - T	2030	Bolted Steel Tank Rehabilitation	$ 2,160,000
37.1	2030	Trace Dev. and Old Bastrop Extension to Francis Harris (8")	$ 200,000
37.1	2030	Trace Dev. and Old Bastrop Extension to Francis Harris (12")	$ 500,000
37.2	2030	Francis Harris Extension	$ 250,000
38 - W	2035	Add Well Capacity	$ 1,450,000
39	2035	Old Bastrop Extension 2	$ 1,660,000
40	2035	Centerpoint South Extension	$ 1,020,000
41	2035	South LBJ Upgrade	$ 400,000
42	2035	Old Bastrop Extension 3	$ 950,000
43	2035	Tanger Loop	$ 510,000
44	2035	IH 35 Frontage Upgrades	$ 1,850,000

P – Pump Station Project
T – Tank Project
W – Well Water Project

In developing the above CIP cost opinions, the Texas Water Development Board's (TWDB) Unified Costing Model (UCM) was used as a guide for pipelines and pump stations (UCM Update February 2019). New pump stations were estimated using UCM values as a function of required horsepower (HP). All costs based on the UCM values were then updated from the last UCM publication in February 2019 to August 2022 dollars using Engineering News Record (ENR) construction cost index (CCI) values. The ENR value from February 2019 was 11213 and the ENR value from August 2022 was 13171, resulting in an increase factor of 1.17.

For pipelines, cost opinions per linear foot were determined by assuming substrate type in the area (rock or soil) as well as the development density along the developed route (urban or rural), and then looking up the value for the proposed diameter in the appropriate table in the UCM. The UCM cost was then brought to present value using the ENR CCI.

For new pump stations, required HP was determined and recent bid tabs were used to develop cost opinions for stations with HP values from 80 to 200. Stations with HP values outside this range were interpolated from the UCM table for new pump stations which use $150 / HP to estimate pump station costs. Costs were then brought to present value using the ENR CCI.

For tanks, recent bid tabulations, detailed cost opinions, and UCM values were compared to estimated costs for new tanks. Costs were then brought to present value using the ENR CCI.

Land costs associated with easements were estimated using recent Texas A&M Real Estate Research Center land prices for the Blacklands – South Region. When looking at the data for the years 2010-2021, the average cost per acre was $933. When zooming in on the last 5 years, the average cost per acre increased to $1,134.

The remaining cost assumptions are summarized below in Table 4.

Table 4: CIP Conceptual Cost Assumptions

Project Cost Assumption	Value	Units
Interest During Construction	3.0%	
Rate of Return on Investments	0.5%	
Construction Period	1.0	years
Engineering, Legal, & Contingencies (Pipes)	30%	
Engineering, Legal, & Contingencies (All Other Facilities)	35%	
Debt Service Period	20	years
Annual Interest Rate	3.5%	
Operations & Maintenance (Pipelines)	1.0%	% of Capital Costs
Operations & Maintenance (Pump Stations)	2.5%	% of Capital Costs
Power Costs	$0.08	/ kilowatt-hour

Table and assumptions derived from the TWDB UCM February 2019 Cost Model.

The conceptual cost opinions were developed using August 2022 unit costs and cost approximations. If, in the future, the conceptual costs need to be updated, the ENR CCI multiplier can be applied to the cost opinion to approximate the change in material and labor prices over the period since August 2022.

2022 CIP Number		Year	Project Priority	Project Category	Project Name	Dia. (in)	Description	Length (ft)	Soil Type	Rural / Urban	Crossing Length (ft)	Crossing Unit Costs	$/LF (2022)	Line Placement	Project Cost	Land Acquisition	Surveying	Engineering	Environmental	Loan Interest	Opinion of Probable Cost
1		2025	**High**	**Capacity**	Replace Comanche Pumps	16	New Pumps at Comanche to fill RR 12 & 50 LF 16" yard piping	51	Soil					City Property	$ 2,400,000					$ 66,000	$ 2,470,000
1 - P		2025				Pumps															
2		2025	**High**	**Development**	Replace Soyars Pumps	Pumps	Replace Soyars pumps to fill the 936' Pressure Plane (2020) and Kissing Tree in 2025.														$ 1,430,000
3		2025	**High**	**Operational Benefit**	Willow Creek Connections to McCarty Pressure Plane	8	Two connections between the Willow Creek service area and McCarty pressure plane for redundant water sources (well water from McCarty or surface water through Purgatory PRV).	690	Soil	Rural			$ 116	Neighborhood	$ 80,040	$ 539	$ 1,000	$ 24,012	$ 3,267	$ 3,000	$ 120,000
4		2025	**Medium**	**Operational Benefit**	Southwest 810' Plane Loop	12	Connect Centerpoint to Transportation Way in the 810' plane.	5,320	Soil	Rural			$ 200	Easement / Industrial then Rural	$ 1,064,000	$ 4,155	$ 3,000	$ 319,200	$ 25,189	$ 30,000	$ 1,450,000
5		2025		**Operational Benefit**	Stagecoach Trail Extension	12	Extend line from end of Stagecoach to intersection of Belvin and Bishop (existing 12" tie in).	2,400	Soil	Rural	500	$ 422	$ 200	Easement / Rural (Stream Crossing)	$ 691,073	$ 1,874	$ 3,000	$ 207,322	$ 13,731	$ 20,000	$ 940,000
6		2025		**Operational Benefit**	Rattler Road Loop	12	Complete 12" loop around the high school on Rattler Rd.	2,430	Soil	Urban			$ 220	Easement / Rural & City Street (School)	$ 534,600	$ 1,898	$ 3,000	$ 160,380	$ 11,506	$ 15,000	$ 730,000
7		2025		**Development**	South Hunter Rd Loop	12	Connect existing 12" (on 810 plane) in Hunter Rd to 12" in Industrial Fork Rd.	3,840	Rock	Urban + Road Crossing	115	$ 422	$ 179	Easement / Rural & City Street	$ 735,907	$ 2,999	$ 3,000	$ 220,772	$ 18,182	$ 21,000	$ 1,010,000
8		2025		**Capacity**	Patricia and Sunset Acres	12	Upsize 2" line along Del Sol Dr and 8" line along Patricia Dr. to each be 12" diameter as a part of the Sunset Acres drainage project.	2,730	Soil	Urban			$ 200	City Roads	$ 546,000			$ 163,800	$ 12,926	$ 16,000	$ 1,090,000
9		2025		**Capacity**	Leah Ave Extension	12	Install 12" to connect Leah Ave between Cottonwood Pkwy and Clovis Barker	2,510	Soil	Urban			$ 200	Easement / Rural & City Street	$ 502,000	$ 1,960	$ 3,000	$ 150,600	$ 11,884	$ 14,000	$ 690,000
10		2025		**Operational Benefit**	Upgrade IH-35 Crossings	16	Upgrade 5 existing water line crossings (8" / 12") to be 16" Between McCarty & Aquarena Springs Rd. These IH-35 crossings are existing but need to be upgrades for 810' water.	1,490	Rock	Urban			$ 652	Road Crossing IH-35	$ 970,839		$ 10,000	$ 339,794	$ 7,055	$ 27,000	$ 1,360,000
11		2025		**Operational Benefit**	Railroad Crossing and Upgrades	12	Upgrade IH 35 crossing near the railroad crossing and upsize the 8"/10" lines to the east of IH 35 near the Conn's shopping center.	2,280	Rock	Urban	800	$ 422	$ 179	Easement & City Street	$ 745,499		$ 5,000	$ 223,650	$ 14,583	$ 21,000	$ 1,010,000
12		2025		**Development**	Big Hat Feed	12	Install 12" from McCarty behind the Premium outlets to the 24" to feed new industrial development and 18" line to serve Gas Lamp.	3,890	Soil	Rural			$ 200	Easement / Rural	$ 778,000	$ 3,038	$ 3,000	$ 233,400	$ 18,419	$ 22,000	$ 1,060,000
13		2025		**Development**	Airport Extension	12	Extend 12" northeast along HWY 21	9,010	Soil	Rural			$ 200	Easement	$ 1,802,000					$ 50,000	$ 1,860,000
14		2025	**High, Need to meet ARWA schedule for receiving flow**	**Development**	Blanco Vista EST	24	Build 1.0 MG elevated storage tank and 24" outlet line to Blanco Vista Blvd	1,570	Rock				$ 267	Development	$ 348,599	$ 1,226	$ 3,000	$ 104,580	$ 7,434	$ 10,000	$ 480,000
14 - T		2025				EST									$ 5,200,000					$ 143,000	$ 5,350,000
16		2025	**High, Need to meet CRWA schedule for receiving flow**	**Capacity**	12" Connection for CRWA Share	12	CRWA WTP HSPS 12" connection to proposed 12" line in Hwy 80.	5,900	Soil	Street Crossing	327	$ 422	$ 179	Easement / Rural	$ 1,194,458	$ 4,608	$ 3,000	$ 358,337	$ 27,936	$ 33,000	$ 1,630,000
17 - T	**(D)**	2025		**Development / Capacity**	Kissing Tree Tank	EST	New 0.50 MG Elevated Storage for 936' pressure plane														
18 - P	**(D)**	2025		**Development / Capacity**	Kissing Tree PS	Pumps	Pumps to fill La Cima Tank and deliver to 1063' pressure plane														
18	**(D)**	2025				16		1,110													
20	**(D)**	2025		**Development**	Kissing Tree Loop - Phase 2a	24	Central Loop in Development Phase I	2,400													
22		2025	**Medium, Depends on the completion of the Trunk Hill tank and PS.**	**Operational Benefit**	Kissing Tree - Kingswood Line	12	Connect Kissing Tree to Kingswood neighborhood by coming down Lazy Ln (include flow control valve). Note that if Kissing Tree develops the area around the proposed route, then Kissing Tree can oversize to 12" in their project.	6,020	Rock	Rural			$ 200	Development	$ 1,204,000	$ 4,702	$ 3,000	$ 361,200	$ 28,504	$ 34,000	$ 1,640,000
23		2025	**Low**	**Operational Benefit**	Kissing Tree - Deerwood Line	12	Connect Kissing Tree Loop to Trails End	4,120	Rock	Rural			$ 200	Development	$ 824,000	$ 3,218	$ 3,000	$ 247,200	$ 19,508	$ 23,000	$ 1,120,000
24	**(D)**	2025		**Development**	Kissing Tree - McCarty Line	16	Connect Kissing Tree Loop to 16" KT line from McCarty Ln.	5,010													
25		2025	**Low**	**Operational Benefit**	Airport Loop	12	Connect IH 35 to HWY 21 along Harris Hill Rd, creating a loop for the northeast service area.	9,800	Soil	River Crossing + Rural	500	$ 422	$ 179	Easement (Mainly Ru	$ 1,965,273	$ 7,654	$ 3,000	$ 589,582	$ 46,402	$ 55,000	$ 2,670,000
26		2025	**High**	**Capacity**	Old Ranch Road 12 Parallel Comanche Outlet Main	12	Parallel of existing 16" Comanche PS discharge line between Holland and Craddock.	6,990	Rock	Urban			$ 200	Easement	$ 1,398,000			$ 419,400	$ 33,097	$ 39,000	$ 1,890,000

2022 CIP Number		Year	Project Priority	Project Category	Project Name	Dia. (in)	Description	Length (ft)	Soil Type	Rural / Urban	Crossing Length (ft)	Crossing Unit Costs	$/LF (2022)	Line Placement	Project Cost	Land Acquisition	Surveying	Engineering	Environmental	Loan Interest	Opinion of Probable Cost
27		2030		**Operational Benefit**	Kissing Tree - La Cima Loop - Connect to Estates of San Marcos	8	Connect the Estates of San Marcos to the 1063' pressure plane with an 8" tee and 8" pipe from the new 16" Kissing Tree-La Cima connection (See CIP 28).	1,310	Rock	Rural			$ 116	Development	$ 151,960	$ 1,023	$ 3,000	$ 45,588	$ 6,203	$ 5,000	$ 220,000
28		2030		**Operational Benefit / Capacity**	Kissing Tree - La Cima Loop - Primary	16	16" cross country pipeline from the new Kissing Tree Truck Hill Elevated Storage Tank to La Cima neighborhood. Also connect this loop to existing neighborhood (Estates of San Marcos) with an 8" new line along W. McCarty Ln. New 8" needs PRV to reduce pressure to 95 psi. (See CIP 27)	17,970	Rock	Rural			$ 220	Development / Rural	$ 3,953,400	$ 14,034	$ 7,500	$ 1,186,020	$ 85,085	$ 109,000	$ 5,360,000
29		2030		**Operational Benefit**	McCarty Tank Fill/Drain Line	12	Connect McCarty Standpipe to 810 plane via Stagecoach. McCarty should now be operated at 810' (max elev is 857') and serve as elevated storage for the 810' plane.	8,380	Rock	Urban			$ 200	Easement / Urban	$ 1,676,000	$ 6,545	$ 3,000	$ 502,800	$ 39,678	$ 47,000	$ 2,280,000
30		2030		**Operational Benefit**	US 80 Loop	12	Extend 12" line from existing 30" along SH 80 to edge of CCN, then north along property boundaries to connect to dead end at airport.	12,550	Soil	Rural			$ 179	Easement (Mainly Ru	$ 2,246,450	$ 9,801	$ 3,000	$ 673,935	$ 59,422	$ 62,000	$ 3,060,000
31		2030		**Operational Benefit**	PGM of Texas Extension	12	Install new 12" line along the proposed roadway alignment which connects to the PGM of Texas access drive. Tie into 16" along IH 35, 12" in Leah Ave, and 24" behind Amazon.	3,610	Soil	Urban			$ 179	Easement	$ 646,190		$ 5,000	$ 193,857	$ 17,093	$ 18,000	$ 890,000
32		2030		**Development**	Trace Dev. Connection	12	Connect development on the south end to 16" along IH 35	320	Rock	I-35 Crossing		$ 704		Bore Below IH-35	$ 221,204		$ 5,000	$ 66,361	$ 1,515	$ 7,000	$ 310,000
33		2030		**Operational Benefit**	Old Bastrop Extension 1	12	Connect the 16" along Old Bastrop Rd to the East to the 18" line north of Cottonwood and complete 12" line on Redwood south to connect at Old Bastrop.	5,100	Soil	Redwood Drive Crossing		$ 422	$ 179	Easement / Rural & Urban	$ 961,447	$ 3,983	$ 3,000	$ 288,434	$ 24,148	$ 27,000	$ 1,310,000
34		2030		**Capacity / Development**	North Side Connection for ARWA BV EST Water	12	Connect to 12" lines in Whisper and continue 12" to the east toward Hwy 21. Connect to 12" in Hwy 21 at the intersection with William Petus.	8,850	Soil	Rural			$ 179	Easement (Mainly Ru	$ 1,584,150	$ 6,912	$ 3,000	$ 475,245	$ 41,903	$ 44,000	$ 2,160,000
36 - T		2030		**Operational Benefit / Capacity**	Bolted Steel Tank Rehabilitation	Tank	Bolted steel tank rehabilitation project as requested by Ron Riggins and Bruce Noel. Intended to cover inspection and rehabilitation of the tank panels at the RR 12 GST and Comanche Standpipe.														$ 200,000
37.1	**(D)**	2030		**Development**	Trace Dev. and Old Bastrop Extension to Francis Harris	8	This project includes the proposed 8" line to be installed by Trace Development on the south portion of their property, along their commercial frontage. The align will be from Posey Rd. to Francis Harris.	3,070	Soil	Rural			$ 116	City Roads	$ 356,120	$ 2,398	$ 1,000	$ 106,836	$ 14,536	$ 10,000	$ 500,000
37.1	**(D)**	2030		**Development**	Trace Dev. and Old Bastrop Extension to Francis Harris	12	This project includes the proposed 12" line to be installed by Trace Development on the south portion of their property, along their commercial frontage. The align will be from Posey Rd. to Francis Harris.	1,010	Soil	Rural			$ 179	City Roads	$ 180,790	$ 789	$ 1,000	$ 54,237	$ 4,782	$ 5,000	$ 250,000
37.2		2030		**Industrial**	Francis Harris Extension	8	Extend a new 8" line to the Francis Harris to power plant from Trace 12" line in Old Bastrop.	8,830	Soil	Rural			$ 116	City Roads	$ 1,024,280		$ 1,000	$ 307,284	$ 41,809	$ 29,000	$ 1,410,000
38 - W		2035		**Operational Benefit**	Add Well Capacity	Well	Add groundwater well at Comanche.										$ 3,000				$ 1,450,000
39		2035		**Development / Capacity**	Old Bastrop Extension 2	16	Rattler to Centerpoint Extension along Old Bastrop Highway	6,090	Soil	Rural			$ 200	Easement	$ 1,218,000	$ 4,756	$ 3,000	$ 365,400	$ 28,835	$ 34,000	$ 1,660,000
40		2035		**Operational Benefit**	Centerpoint South Extension	12	Install 12" perpendicular to Old Bastrop to 12" Existing Line and connect to end point of 12" in Centerpoint Rd. near the Master's School.	3,720	Soil	Rural			$ 200	Easement	$ 744,000	$ 2,905	$ 3,000	$ 223,200	$ 17,614	$ 21,000	$ 1,020,000
41		2035		**Operational Benefit**	South LBJ Upgrade	12	Upgrade small diameter line in S. LBJ from E. Grove St. to IH-35 Crossing	1,630	Rock	Urban			$ 179	City Roads	$ 291,770		$ 1,000	$ 87,531	$ 7,718	$ 9,000	$ 400,000
42		2035		**Development / Capacity**	Old Bastrop Extension 3	12	Centerpoint to Horace Howard Extension along Old Bastrop Highway, Include connection to existing line on Horace Howard Dr.	3,460	Soil	Rural			$ 200	Easement	$ 692,000	$ 2,702	$ 3,000	$ 207,600	$ 16,383	$ 20,000	$ 950,000
43		2035		**Operational Benefit**	Tanger Loop	12	Connect existing 24" to end of proposed 12" developer line along IH-35 north of Centerpoint (Behind Bill Miller's)	2,060	Soil	Rural			$ 179	Easement	$ 368,740	$ 1,609	$ 3,000	$ 110,622	$ 9,754	$ 11,000	$ 510,000
44		2035		**Operational Benefit**	IH 35 Frontage Upgrades	12	Upgrade IH 35 lines along northbound side to 12" pipes from tan warehouse building north of McCarty to the northeast until Wonder World Dr.	6,180	Soil	Urban			$ 220	Easement	$ 1,359,600		$ 7,500	$ 407,880	$ 29,261	$ 38,000	$ 1,850,000

THE CITY OF SAN MARCOS

BLANCO VISTA TANK
2025 - CIP 14

CIP 14 - 24-inch

CIP 34 - 12-inch

CIP 25 - 12-inch

CIP 13 - 12-inch

RR 12
TANK / PS

LA CIMA
TANK

COMANCHE TANK / PS
2025 CIP 01
COMANCHE WELL
2035 CIP 37

SPRING LAKE
TANK / PS

CIP 11 - 12-inch

SURFACE WATER
TREATMENT PLANT / HSPS

CIP 30 - 12-inch

CIP 41 - 12-inch

CIP 10 - 16-inch
(TYP 5)

CIP 16 - 12-inch

CIP 27 - 8-inch

CIP 29 - 12-inch

CIP 28 - 16-inch

CIP 05 - 12-inch

CIP 24 -
16-inch

MC CARTY
TANK / PS

CIP 08 - 12-inch

CIP 22 - 12 -inch

CIP 44 - 12-inch

CIP 09 - 12-inch

TRUNK HILL
TANK / PS
2025 CIP 17 + 18

CIP 20 -
24-inch

SOYARS
TANK / PS
2025 - CIP 02

CIP 03 -
8-inch
(TYP 2)

CIP 31 - 12-inch

KINGSWOOD
TANK / PS

CIP 23 - 12 -inch

CIP 33 - 12-inch

CIP 43 - 12-inch

OAKRIDGE
TANK / PS

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COTTONWOOD
TANK

CIP 32 -
16-inch

CIP 37.1 - 8-inch
12-inch

CIP 37.2 - 8-inch

Pressure Reducing Valves (PRVs)

Maintenance Projects

Existing Water Facilities

CIP Water Facilities

CIP Pipe Lines

2025

2030

2035

Future Pressure Planes

810

936

1060

PLUMMER

ATTACHMENT B
CIP MAP - 2022 UPDATE

Plummer Associates, Inc
6300 La Calma Dr. Suite 400
Austin, Texas 78752
Date: 12/9/2022

Document Path: M:\Projects\0600\018-01\20220331 FA 1 - CIP Update - Hannah\CIP Figure.mxd

TECHNICAL MEMORANDUM

Water Distribution System Model Update to 2022 Conditions

Miscellaneous Water Modeling

City of San Marcos

PREPARED FOR	Shaun Condor, PE City of San Marcos
PREPARED BY	Hannah Leppla, PE (TX No. 130165) Plummer Associates, Inc.
cc	Stephen J. Coonan, PE, Principal
DATE	December 9, 2022
VERSION	1
PROJECT NO.	0600-018-03 Fund Allocation #1
FILE DIRECTORY	m:\projects\0600\018-01\20220331 fa 1 - cip update - hannah\task 1 - model update to 2022\20220622 model update - fa 1 - task 1.docx

PLUMMER

Texas Registered Engineering Firm F-13

1 INTRODUCTION

The purpose of this memo is to present and discuss the updates to the calibrated InfoWater model to bring the distribution system up to date with the existing 2022 conditions. The previous Water Master Plan model was representative of the 2019 meter demands and pipeline network. In the past 3 years, there has been an increase in the water demand on the City's system and new pipe networks have been installed.

New data includes:

- 2022 GIS Data for Pipelines
- 2022 GIS Data for Customer Meter Locations
- 2021 Monthly Meter Consumption Data

Table 1 summarizes the changes to the model system and Figure 1 shows a chart demonstrating the changes.

Table 1: Model Component Comparison

System Component	2019 Model	2022 Model
8" and Smaller Dia. (miles) [1]	171.7	198.2
10" - 12" Dia. (miles) [1]	69.3	75.4
16" - 24" Dia. (miles) [1]	42.4	43.1
Greater than 24" Dia. (miles) [1]	4.5	4.5
Customer Meters – Excel (units) [2]	12,617	14,700
Customer Meters – GIS (units)	12,792	14,752
Annual Average Demand (gpm) [3]	5,808	5,964
Annual Average Demand (MGD)	8.4	8.6

[1] LIFECYCLE = ACTIVE; WATERTYPE = POTABLEWATER; OWNERSHIP = COSM

[2] Based on unique account numbers.

[3] Annual average demand for the 2022 model build is based on 2021 meter data.

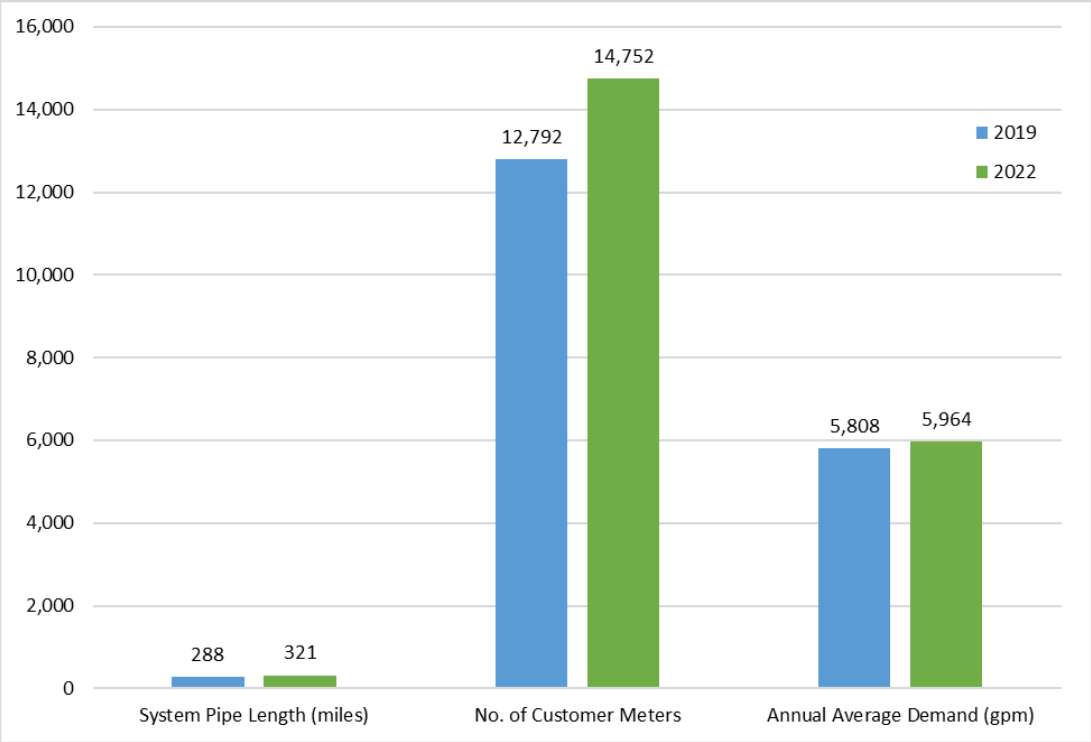

Figure 1: Comparison of Water Model Updates

2 PIPE NETWORK UPDATES

The pipe network has expanded mainly in the area where new residential developments are being constructed. Figure 2 shows five (5) areas highlighted in blue where the model pipe network was expanded.

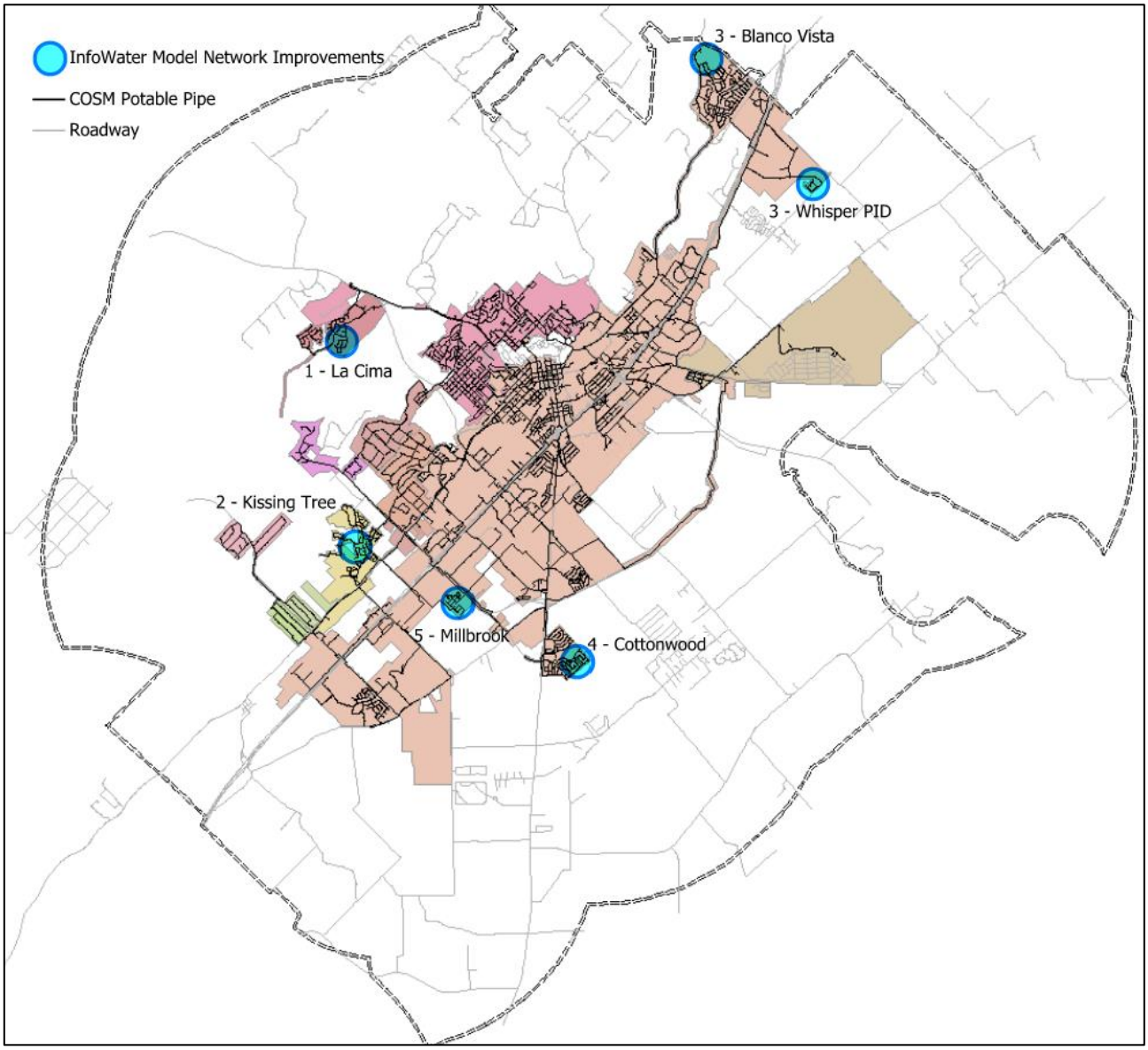

Figure 2: Water Distribution System as of October 2022 with Network Improvements

3 SERVICE AREA DEMAND UPDATES

The following section describes the updates to the water model based on the new meter data received. The annual average potable water demand calculated from the 2021 meter data was 5,964 gpm (8.6 MGD). The demand has increased 2.7% from 2019 to 2021, primarily from an increase in number of customers served.

Table 2: Population and Demand Updates

	Service Area Population Estimate	Projected GPCD [1]	Average Day Demand Estimate (gpm / MGD)
2019 [2]	65,234	128	5,808 / 8.4
2021 [3]	**70,337**	**122**	**5,964 / 8.6**
2022 [4]	86,717	-	-
2025	89,372	116	7,199 / 10.4
2030	102,695	114	8,130 / 11.7
2035	133,701	112	10,399 / 15.0

[1] GPCD projections have recently been updated by the City's Water Conservation and Drought Response Plan (April 2019). The projections presented in the plan predict a demand of 112 gpcd in 2025, 110 gpcd in 2030, and 109 gpcd in 2035. For the purposes for the planning document, the higher demands shown in the table were used when predicting future water supply and infrastructure needs.
[2] From the 2020 WMP Document. Represents 2019 meter data evaluation.
[3] Population back-calculated from 2021 meter data and average projected GPCD.
[4] Region L population projections for 2022.

From the existing model, a new scenario was created to simulate the 2022 existing condition and 2021 meter demand. Because the increase in demand was not focused in one area of the system and because the system network improvements from Figure 2 were distributed across the City's pressure planes, the 2019 demands at each modeled node were increased by 2.7% to represent the new 2021 demand.

4 PRESSURE PLANE UPDATES

The updated 2022 model also accurately reflects the City's current pressure planes by simulating closed valves and pressure reducing valves in different areas of the distribution system. Two (2) notable areas of change are the Hwy 21 pressure zone to the northeast and Deerwood to the southwest.

The service area to the northeast along Hwy 21, is located in the 810' pressure plane (main pressure zone) and should be served off of the 810' distribution system. There is a backup connection with a PRV from the high service transmission main to the 12" line along Hwy 21. Currently, the customers along Hwy 21 are served through the PRV, creating a separate pressure plane from the 810' pressure plane.

Previously, Deerwood was served through the Oakridge booster pump station and hydropneumatics tank. Because the goal is to serve Oakridge and Deerwood via the Soyars pressure plane, an interim step has been taken to isolate Deerwood from Oakridge and to serve Deerwood through the 12" line in Hunter Rd. This brings Deerwood onto the Soyars pressure plane.

There are still ten (10) pressure planes being operated in the City's system as of October 2022. The ultimate goal is to build out the potable water distribution system and operate three (3) pressure planes.

Figure 3 shows the current pressure planes and the locations of the PRVs. Table 3 shows the conversion of the existing pressure planes into the future, proposed pressure planes.

Table 3: Pressure Plane Consolidation

2022 Pressure Planes	Future Pressure Planes
810' Pressure Plane (Main Pressure Zone)	810' Pressure Plane
Hwy 21	
936' Pressure Plane (Comanche)	936' Pressure Plane
McCarty Well	
Willow Creek	
Soyars	
Oark Ridge	
1063' Pressure Plane (La Cima)	1063' Pressure Plane
Estates and San Marcos [1]	
Kingswood	

[1] Estates of San Marcos will be served by the 1063' Pressure Plane but will require a PRV.

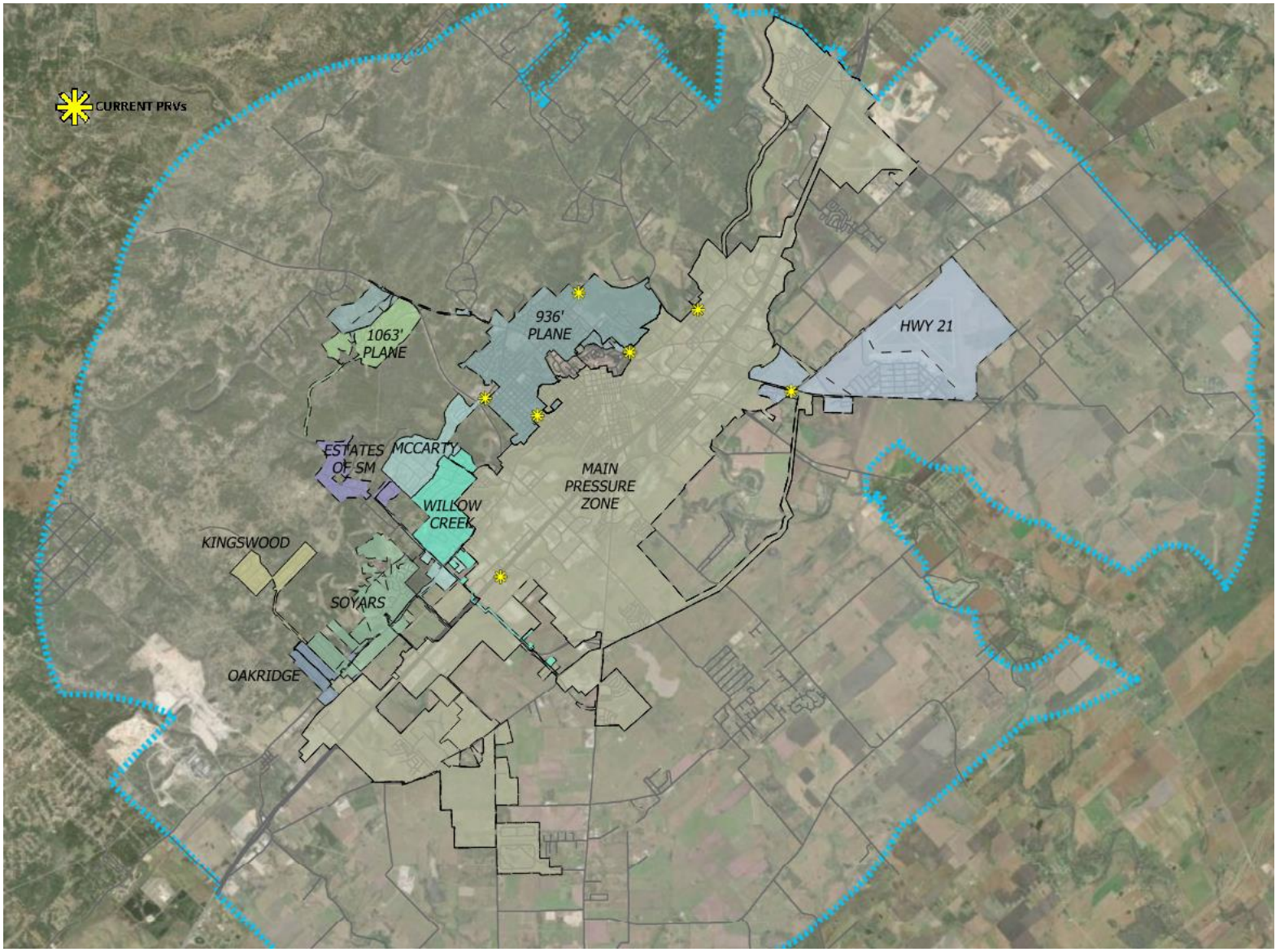

Figure 3: 2022 Current Pressure Planes

THE CITY OF SAN MARCOS

BLANCO VISTA TANK
2025 - CIP 14

CIP 14 - 24-inch

CIP 34 - 12-inch

RR 12
TANK / PS

LA CIMA
TANK

COMANCHE TANK / PS
2025 CIP 01
COMANCHE WELL
2035 CIP 37

SPRING LAKE
TANK / PS

CIP 25 - 12-inch

CIP 13 - 12-inch

CIP 26 - 12"
See Tech
Memo dated
9/9/2020

CIP 11 - 12-inch

SURFACE WATER
TREATMENT PLANT / HSPS

CIP 41 - 12-inch

CIP 05 - 12-inch

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(TYP 5)

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CIP Water Facilities

CIP Pipe Lines
2025
2030
2035

Future Pressure Planes
810
936
1060

PLUMMER

ATTACHMENT B
CIP MAP - 2022 UPDATE

Plummer Associates, Inc
6300 La Calma Dr. Suite 400
Austin, Texas 78752
Date: 12/9/2022

Document Path: M:\Projects\0600\018-01\20220331 FA 1 - CIP Update - Hannah\CIP Figure.mxd